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FISHERY·RESOURCES

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FISH AND WILDLIFE SERVICE

U. S. DEPARTMENT OF THE INTERIOR

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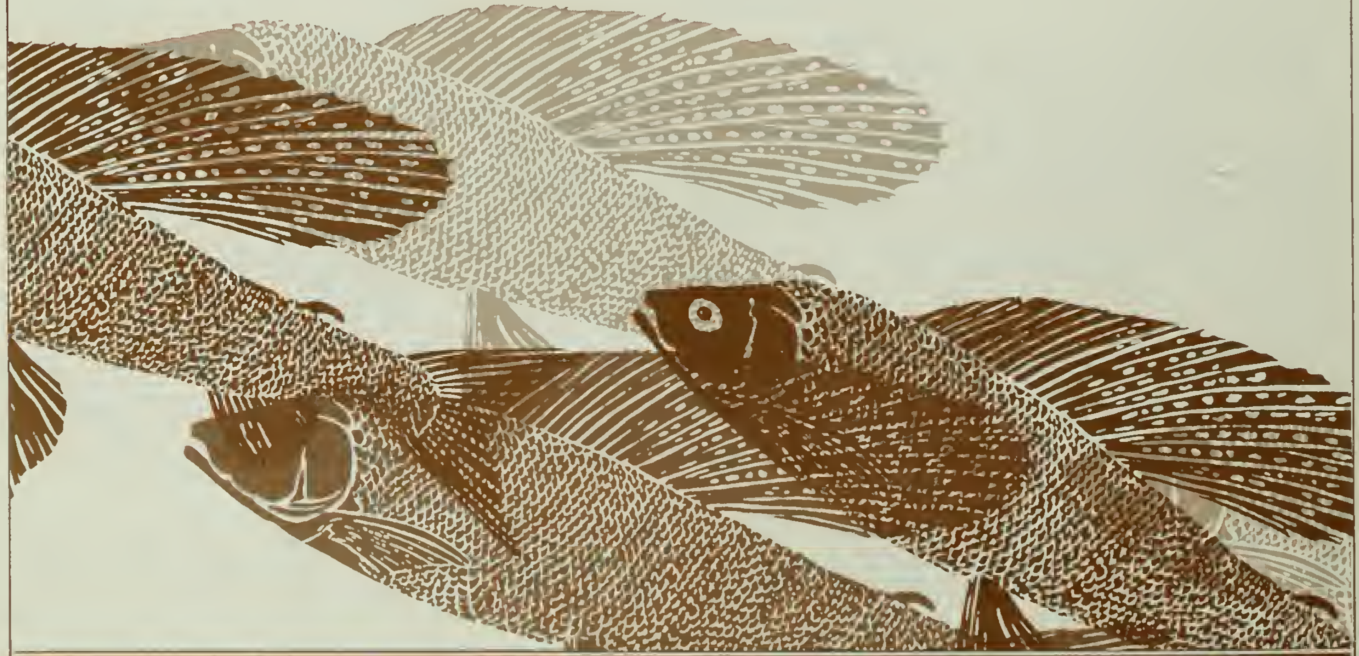
The Fish and Wildlife Service of the U.S. Department of the Interior is the Nation's principal fishery conservation agency. The Service is responsible for the preservation and protection of fish and wildlife and their habitats on all public, interstate, Federal and Indian lands. The primary role of the Service is to foster the wise use of fish and wildlife resources while at the same time managing and conserving these resources in order to provide continuous benefits for future generations. As part of the Fish and Wildlife Service, the Fishery Resources Program, in cooperation with the States and other Federal agencies, is dedicated to the restoration, improvement, and maintenance of the quality, use, and abundance of the Nation's recreational and commercial fishery resources.

INTRODUCTION

The goals of the Fishery Resources Program are to:

- Establish, maintain, restore, and enhance fishery resources.
- Assure consideration of fishery resources in all Federal water projects.
- Aid States, other Federal agencies, the military, and Indians in the management and development of fishery resources.
- Control the introduction or spread of diseases and parasites harmful to fishery resources.
- Maintain an informed public and be responsive to the needs of the people.
- Promote a high level of competence and expertise among Service and non-Service professionals.



Activities of the Fishery Resources Program

Fishery Resources Program goals are attained through a combination of seven activities: fishery assistance, fish hatchery production, fishery research, fishery training, grants, law enforcement, and construction. These activities are described briefly as follows.

Fishery Assistance
Thirty-three fishery assistance field stations provide assistance in fishery resource management for Federal, State, and Indian waters where such effort is needed or mandated to manage, conserve, and perpetuate fishery resources of importance to the national interest and the mission of the Service. Often, cooperative agreements for technical assistance are negotiated between the Service and other Federal and State

agencies. A summary of fishery assistance on areas served during Fiscal Year 1978[1] is presented in the Appendix.

Fish Hatcheries

The National Fish Hatchery System includes hatcheries; fish cultural development centers; the National Aquarium in Washington, D.C.; and some special spawning facilities on the Sacramento River in California. Hatcheries produce and distribute species of fish of the size, number, strain, and quality to meet the resource requirements for which the Federal Government is responsible by statute, cooperative agreements, or other mandates. The number and weight of fish and fish eggs produced and distributed in FY 1978 are given in a table appended to this report.

Production efforts at national fish hatcheries are supported by 17 hatchery biologists and the staffs of five fish cultural development centers. The primary function of hatchery biologists is to assist hatchery managers at Federal, State, foreign, and commercial fish hatcheries in solving fish health problems through inspection, diagnosis, and treatment of diseases. The biologists' diagnostic and inspection activities support the fish health efforts of the Great Lakes Fishery Commission, the Colorado River Wildlife Council, and areas of shared Federal/State responsibilities. Biologists also advise State, foreign, and university fishery officials on matters of fish health and fish culture.

Fish cultural development centers conduct applied research and development in support of the hatcheries. Problems as well as new initiatives in fish culture and distribution are resolved and developed to the point that the resulting information can be utilized by hatcheries.

Fishery Research

The Division of Fishery Ecology Research conducts research responsive to the needs of Servicewide fishery resource programs. Research also responds to needs of international groups, other Federal agencies, Indian tribes, State agencies, and private groups. To coordinate research activities related to fish culture and training, the National Fisheries Center was established in FY 1978 at Leetown, West Virginia. The Center's goal is to efficiently and effectively administer and interrelate various fish husbandry research activities, certain development functions, and fishery training activities into a comprehensive and flexible program. Altogether there are 12 research laboratories and numerous satellite facilities. A considerable amount of fishery research is conducted by Cooperative Fishery Units at various universities; however, their activities are not included in this report.

Grants

The Service participates with the National Marine Fisheries Service in the Anadromous Fish Conservation Act Program. The goal of this program is to restore depleted anadromous fish stocks and their habitats by enhancing existing populations and by creating new anadromous fisheries. These activities are financed

[1] FY 1978 extends from October 1, 1977 to September 30, 1978

with matching State and Federal funds. A table of the distribution of Anadromous Fish Conservation Act funds and a description of anadromous fish projects by State are appended to this report.

Law Enforcement
Enforcement of Federal laws pertaining to fish is directed at international, interstate, and Indian-related activities. The Service also enforces State laws pertaining to fish when these laws are detailed in cooperative agreements or directed by court mandate. Enforcement activities are conducted by the Division of Law Enforcement.

Construction and Engineering
The Division of Engineering, working with the Division of National Fish Hatcheries, the Division of Fishery Ecology Research, and the regional offices, develops project proposals and cost estimates for construction, maintenance, and repair of fishery facilities. Construction and engineering accomplishments are presented in this report under Related Program Areas.

Fishery Resources Program Areas

The activities of the Fishery Resources Program are performed in three related program areas: anadromous fisheries, Great Lakes fisheries, and inland fisheries.

Anadromous Fisheries
Many of the most important commercial fish species are anadromous: the adults migrate from the sea upstream to spawn in ffesh water. Often, migrating fish species such as the Atlantic salmon and chinook salmon along the Pacific coast encounter great difficulties during migration, such as dams and impoundments, polluted streams, and low water levels. In many areas, anadromous fish no longer return to historically important streams to spawn. Measures to restore and protect these fish during migration, spawning, and early growth are very important if continued benefits to fishermen are to be ensured. Fishery resource activities of assistance, production, and research are integrated to help solve some of these problems.

The Atlantic Salmon Restoration Program in the New England States is a good example of this integration. Historically, adult Atlantic salmon migrated up New England rivers and streams; however, impassable dams and pollution eliminated much of this fishery. In most rivers, no wild salmon have been seen in over 100 years. Working with State fish and game agencies and the National Marine Fisheries Service, fishery resources personnel initially are concentrating on the restoration of this spectacular fish into the Connecticut and Merrimack Rivers. Baseline data are being collected on all stages of the Atlantic salmon life cycle in fresh water, from the egg through smolt stage in hatcheries, to survival and food habits in the wild. Studies are underway that document timing and quantity of smolt outmigration and the resultant adult return.

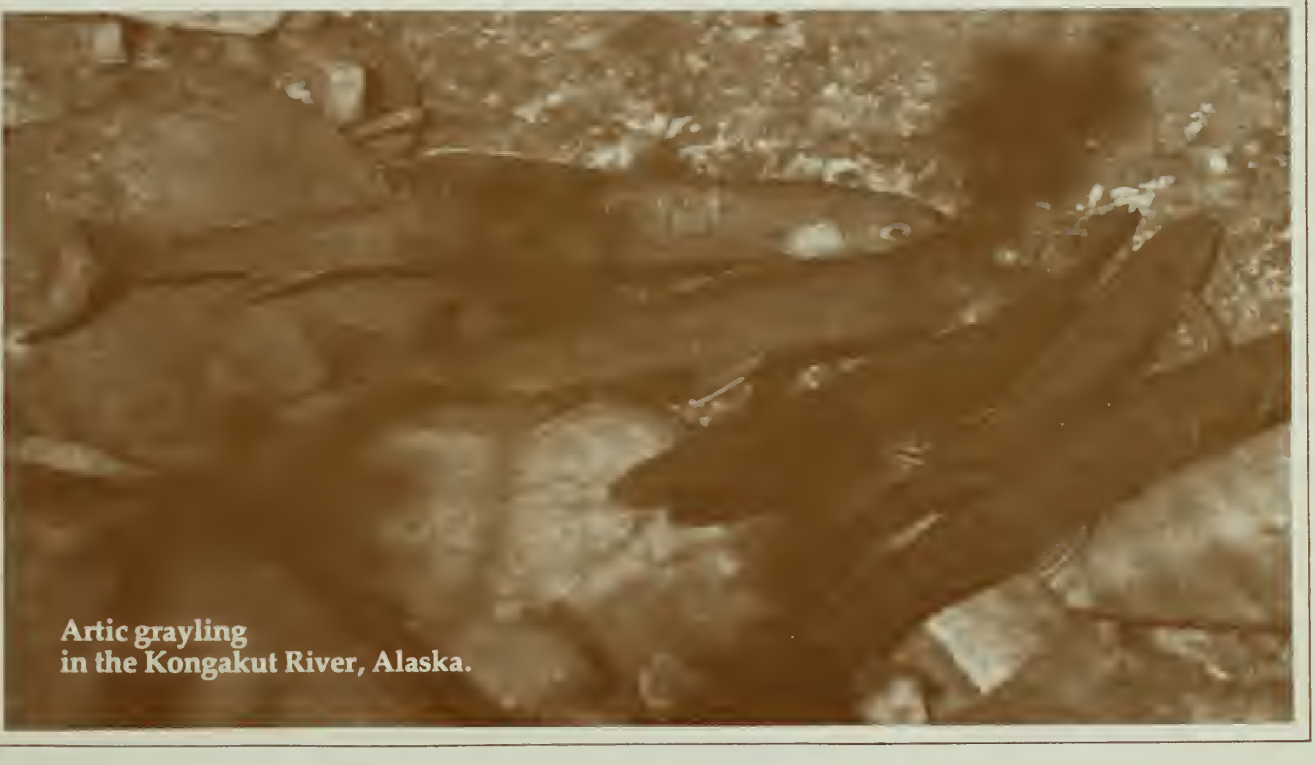
Great Lakes Fisheries
Fishery resources activities are also important to the Great Lakes fishery. Formerly, the Great Lakes provided some of the country's best commercial and recreational fishing, but overfishing, pollution problems, and predation by the sea lamprey nearly decimated lake trout populations and other resident fish species.

The international Great Lakes Fishery Commission (GLFC), created to restore and improve the sport and commercial fisheries of the Great Lakes, contracts with the U.S. Fish and Wildlife Service for sea lamprey control. Adult and larval lamprey populations are monitored, and the larvae are chemically treated. Researchers are investigating chemicals that may reduce lamprey populations and are producing artificially sterilized adult lampreys that are released into the lakes to compete with fertile lampreys for mates. Fish hatchery production is devoted to restoring populations of lake trout, sauger, and other recreational and commercial fish species into the Great Lakes. Assistance is given to the States, Indian tribes, and the GLFC to prepare management plans that favor natural production of important species that will result in eventual self-sustaining populations.

Inland Fisheries

In terms of the area covered and diversity of habitat, inland fisheries is the largest segment of the Fishery Resources Program. This program deals with rivers, streams, ponds, and reservoirs on Federal and Indian lands. These properties include military installations, Veterans' Administration hospitals, national parks, national forests, national wildlife refuges, and Indian reservations. Also included are cooperative efforts with the States on many State waters. Technical assistance to these areas includes development plans, stocking of hatchery-reared fish, collection of wild broodstock and eggs, rehabilitation of polluted streams, and reestablishment of fish, including endangered species, into these streams. Assistance includes training Indians in all aspects of fishery management. Fish production includes warmwater, coolwater, and coldwater species, from smallmouth bass and channel catfish to rainbow trout and chinook salmon.

Investigational activities for inland fisheries concentrate on new and improved fish cultural methods, diagnosis and treatment of diseases, and evaluations to determine which species or strains will do best under various environmental conditions.

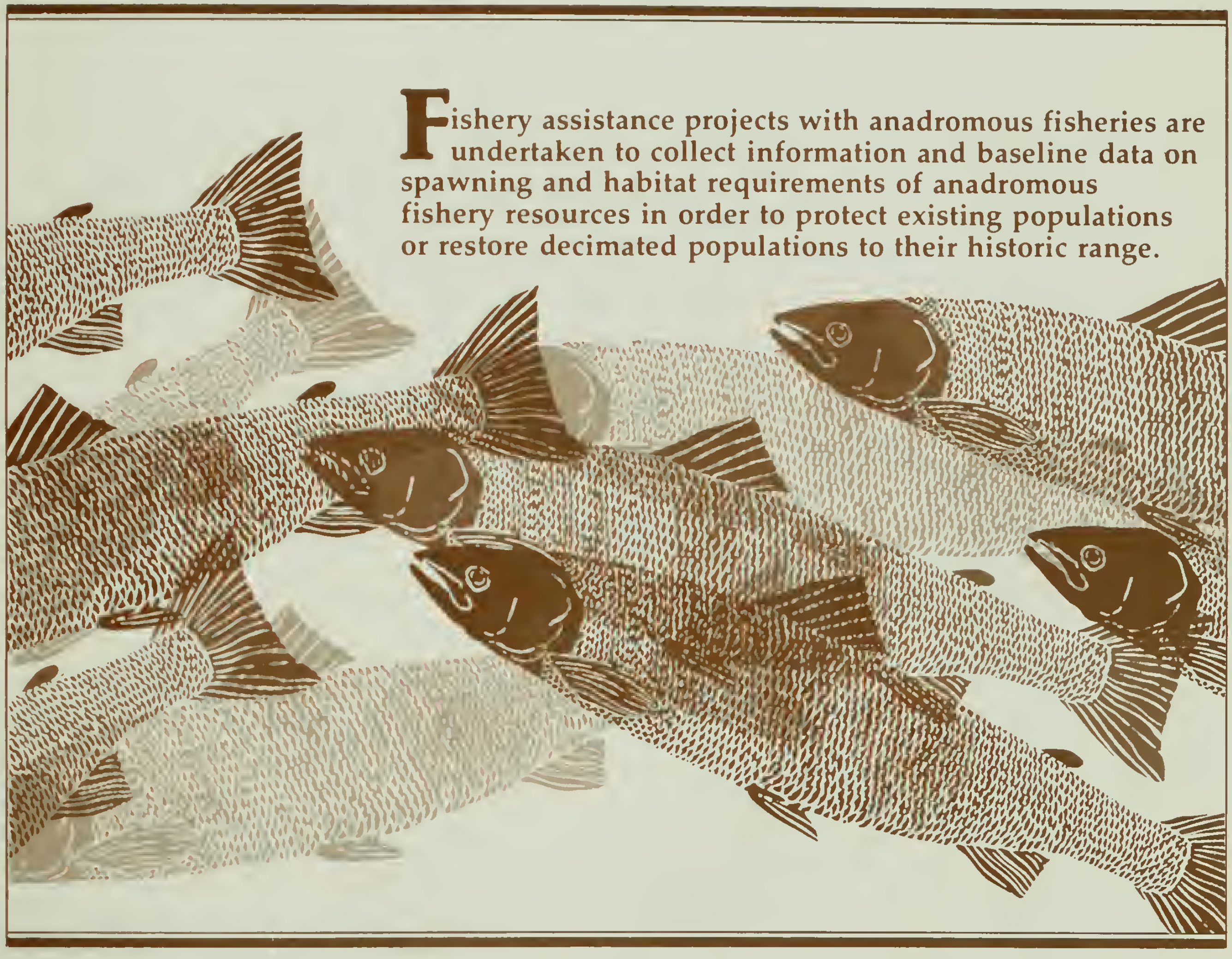


Artic grayling in the Kongakut River, Alaska.

Regional And Area Office Organization

The Fishery Resources Program activities in each of the six regional offices and the Alaska Area Office are managed through the area and field offices dispersed throughout each region. The map in the Appendix shows the regional geographic boundaries, and locations of regional and area offices, fishery assistance field stations, and national fish hatcheries.

Accomplishments of the Fishery Resources Program during FY 1978 are reported under the activities of Fishery Assistance, Fish Hatcheries, and Fishery Research. Accomplishments within the program areas of anadromous fisheries, Great Lakes fisheries, and inland fisheries are included under each of the above activities. Because of the large number of field facilities and activities within the Fishery Resources Program, no attempt is made in this report to cover all locations or activities.



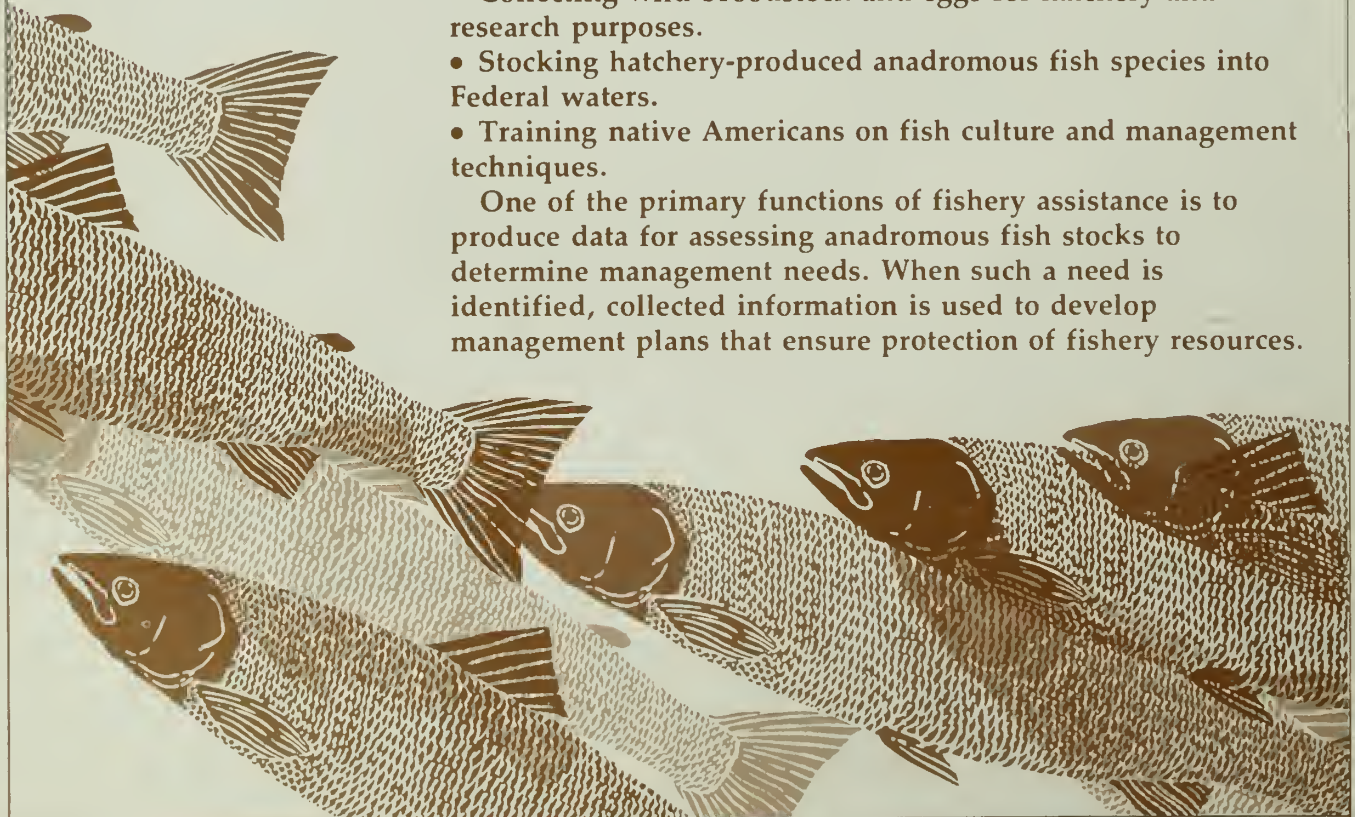
Fishery assistance projects with anadromous fisheries are undertaken to collect information and baseline data on spawning and habitat requirements of anadromous fishery resources in order to protect existing populations or restore decimated populations to their historic range.

FISHERY·ASSISTANCE
ANADROMOUS · FISHERIES

These projects include:

- Collecting information on fishery resources such as distribution and abundance, migratory patterns and habits, delineation of spawning and nursery areas, evaluation of spawning success, surveys, and inventories.
- Preparing fishery management plans based upon these data for Indian reservations, wildlife refuges, national parks, national forests, military installations, river basins, and other areas.
- Collecting wild broodstock and eggs for hatchery and research purposes.
- Stocking hatchery-produced anadromous fish species into Federal waters.
- Training native Americans on fish culture and management techniques.

One of the primary functions of fishery assistance is to produce data for assessing anadromous fish stocks to determine management needs. When such a need is identified, collected information is used to develop management plans that ensure protection of fishery resources.



Surveys Continue on Adak Island, Alaska

Adak Island is one of the Aleutian Islands, and the site of Adak Naval Station. For several years the Alaska Department of Fish and Game (ADF&G) and the Fish and Wildlife Service cooperatively have provided the station with fishery assistance. Nearly 3,700 acres of lakes have been surveyed, and rainbow trout and coho salmon stocked to supplement the sport fishery. In 1978, Service personnel evaluated species composition, age-growth relations, invertebrate densities, and water quality on four streams. Dolly Varden trout, pink salmon, and coho salmon were the primary sport fish in all streams evaluated.

Cooperative Efforts Evaluate Alaskan Sockeye Salmon Spawning

Fishery resources staff and the ADF&G cooperated in a study to evaluate Fall 1978 sockeye salmon spawning in the Russian River System, the most important sockeye spawning grounds on the Kenai Peninsula. Salmon eggs from small test areas in the stream bed were dislodged by high-pressure water jets. Egg density and viability data were used to determine spawning success, environmental effects on hatching, optimum spawning numbers, and the most productive rearing areas. Kenai fishery resources staff also provided ADF&G with aircraft support to check winter snow pack conditions, river flows, fish weir construction, and salmon smolt enumeration work.

Alaskan Environmental Impact Assessment Reviewed

Kenai fishery assistance staff, in cooperation with personnel from the Division of Ecological Services, reviewed the Environmental Impact Assessment prepared by the ADF&G for the proposed Hidden Lake Hatchery. This hatchery would be located within the boundaries of the Kenai National Moose Range, and be capable of hatching about

Biologists sample rainbow trout by gill netting on the Kenai National Moose Range to estimate relative abundance, age, growth, and food consumption.

37.5 million salmon eggs annually. Kenai personnel also assisted State biologists in determining the status of salmon year classes in Glacier Flat Creek by comparing juvenile growth rates to those of previous years.

Supreme Court to Settle Northwest Fishing Rights Dispute

The Olympia, Washington Fishery Assistance Station and Area Office staffs continued preparation of material for the U.S. District Court in a case involving Indian fishing rights in western Washington (Boldt Decision, *U.S.* v. *Washington*, Civil 9213). Fishery resources staff compiled an inventory of habitat degradation for all the major watersheds in western Washington in order to assess the impacts of environmental degradation on the salmon and steelhead resource, and to address whether treaty Indians are entitled to hatchery fish. Reports written by or containing significant contributions from Olympia staff included: "Salmon and Steelhead Production (Hatchery and Wild) from Boldt Case Area River Basins from 1952–1978," "Proposal for a Healthy Commercial Fishery," and "Statistical and Status Report on Steelhead in Washington State." The litigation (*U.S.* v. *Washington*) is now before the U.S. Supreme Court and a decision is expected by June 1979.

Smolt Survival Priority of New Leavenworth Office

During FY 1978, the Fishery Assistance Office at Coulee Dam, Washington was transferred to Leavenworth, Washington. The office now will provide services to a larger geographical area and emphasize anadromous fishery problems in the mid-Columbia River area. Program priorities at Leavenworth emphasize improving survival of smolts produced in the mid-Columbia and determining the contributions of hatcheries to the various sport and commercial fisheries in the area.

Toxic Substances in Fish Populations Studied

The Marrowstone, Washington fishery assistance staff has expanded its analytical capability to more accurately determine concentrations of toxic substances in fish and their environment. In cooperation with the Leavenworth fishery assistance staff and the Colville Confederated Tribes, Marrowstone staff began a baseline study in 1978 on the upper Columbia River in Lake Roosevelt to determine background levels of heavy metals in the fish populations. The data will be used to determine the impact on Columbia River fishery resources of a copper-molybdenum mine, which is being developed on the Colville Indian Reservation.

Catch Monitoring Responsibilities Transferred to Tribes

By Federal Court order, catch-monitoring responsibilities for salmon caught in Washington by Indians were transferred from the Fish and Wildlife Service to the respective tribes. At the request of the Bureau of Indian Affairs (BIA) the Olympia fishery assistance staff is monitoring the transfer of catch-reporting activities to the tribes.

The Olympia staff also monitors catches of treaty and non-treaty fishermen during the sockeye salmon run in northern Puget Sound, an area managed jointly by Canada and the United States through the International Pacific Salmon Fisheries Commission (IPSFC). Catch data are used to formulate regulations for U.S. treaty Indian fishermen on IPSFC waters.

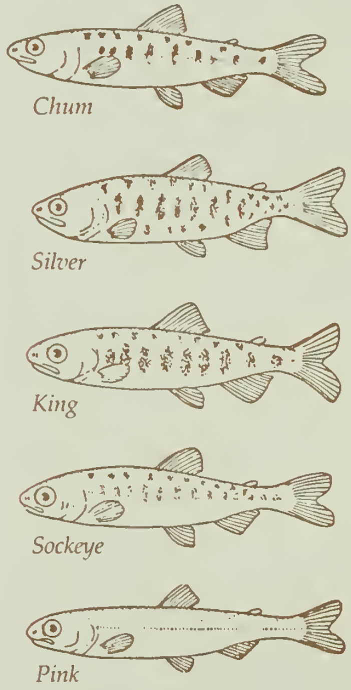
Populations of Salmon and Steelhead Studied

In cooperation with the Washington Departments of Fisheries and Game and the Puget Sound Indian tribes, fishery assistance personnel are studying information on the population dynamics of naturally spawning stocks of salmon and steelhead, particularly in the larger watersheds of Puget Sound. These population studies provide more precise management information on run size and escapement of native stocks, distribution of spawning fish within a watershed, and basic biological information on sex ratios, age composition, and run timing. During the 1977–1978 season, cooperative studies were conducted in the Nooksack, Skagit, Lake Washington, Skokomish, and Nisqually watersheds. Estimates of run size and escapement and other data were made available to interested agencies in the form of preliminary reports. Final reports will be completed upon the conclusion of studies in each watershed on each stock.

In-season estimates of run size and escapement were used by members of the Nisqually Tribe to adjust their fishing effort to meet the required escapement goal. In addition, the tribe, with the aid of fishery assistance staff, installed a fishwheel on the Nisqually River to evaluate its potential as a research tool for assessing adult escapement and for enumeration of outmigrant salmonid smolts.

Lake Ozette Restoration Plan Prepared

During 1978, sockeye salmon escapement was monitored and life-history data were studied in Washington's Lake Ozette by fishery assistance and Young Adult Conservation Corps (YACC) personnel. Data were also collected on other fish species that may compete with sockeye. Following an exhaustive literature review, the Lake Ozette Sockeye Salmon Restoration Plan was prepared. The object of this plan is to identify the factors limiting sockeye production and restore populations from the present annual run of less than 1,000 fish to historical levels of about 40,000 returning adults. Restoration efforts will be accomplished through various Federal, State, tribal, and private agencies.

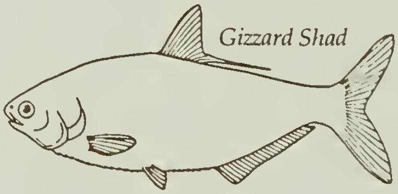


Young Pacific Salmon

Chinook Tagging Program Uses Binary-Coded Tags

A major fall chinook tagging program using binary-coded wire nose tags was initiated at several Columbia River hatcheries in Washington in cooperation with the Columbia River Development Program Office, National Marine Fisheries Service. This study is designed to evaluate the contribution of these hatcheries to the fall chinook fishery and will continue for several years. This activity will involve the marking of about a million smolts annually. Olympia staff tagged 1,660,000 salmon and steelhead during 1978 using the mobile tagging unit.

In a cooperative study among the Clallam Tribe, Northwest Marine Technology, and the Service, two groups of 15,000 fish each were tagged at the Clallam tribal facilities to evaluate the use of a tag that is half the length of the normal tag. The smaller tag is used on fish that are not large enough to accommodate the full-length tag. Various tagging programs to evaluate hatchery returns, contribution to the fishery, and management techniques will continue in FY 1979 with emphasis placed on standardization of techniques and synchronization of the studies with those conducted by other agencies. The mobile tagging unit was also loaned to the State of Oregon to tag 800,000 coho and chinook salmon on the Columbia River.

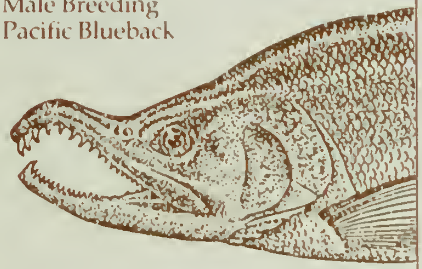


Potential Fisheries Studied on Indian Reservations

At the request of the Columbia River Inter-Tribal Fish Commission, the feasibility of developing or enhancing anadromous fish production on the Umatilla, Yakima (Klickitat River System), and Nez Perce Indian Reservations was studied by Vancouver fishery assistance personnel. All the major water sources on these reservations were surveyed and eight showed potential for support of an anadromous fishery. Water temperature, chemistry, and flow data are being collected for these sources. Streams on the reservations also have been surveyed for migration blocks and sites for potential stream bank improvements. During FY 1979, data will be analyzed and design and engineering of the fish production facilities will be completed.

At the request of the Umatilla Tribe, fishery assistance staff drafted a preliminary outline of a comprehensive fishery management plan for the Umatilla Indian Reservation in Oregon. Also drafted were tribal fishing regulations for the Nez Perce Tribe in Idaho. These regulations pertain to on-reservation and off-reservation fishing sites and cover commercial, ceremonial, and subsistence fisheries. The regulations were presented to the Tribal Executive Committee.

Technical assistance to all Indian tribes in the Washington area emphasizes rehabilitation of native fish populations, cooperative watershed management between tribes and State agencies, and the release of quality fish. These objectives are achieved through local training sessions, workshops sponsored by the Service, and on-site advice to Indian fish culturists. Tribes are also assisted in the development of small tribal hatchery facilities. About 47 million salmon and steelhead smolts were released from tribal hatcheries in 1978.


Male Breeding
Pacific Blueback

Umatilla Flow Study Completed

During FY 1978, fishery assistance staff conducted a flow study on the Umatilla River in Oregon and its tributaries in an effort to quantify the habitat available for anadromous salmonids at various stream flows. Sixteen study reaches were selected for flow measurements that included depth, velocity, and substrate. Data were collected by the U.S. Geological Survey and programed into the Incremental Computer Model developed by the Service's Instream Flow Group in Fort Collins, Colorado. The information generated by the computer model is being analyzed and a report prepared.

Study on Chinook Salmon Completed

A study undertaken in 1975 to develop a more accurate method of run size prediction for spring chinook salmon prior to any fishery in the Columbia River was completed in FY 1978. Fishery data for various anadromous species were collected and stored in a computer at Oregon State University under a contract with the University's Cooperative Fishery Unit. A program was written that allows the data to be updated, specifically retrieved, and manipulated for analysis. The final report, "A Study of Columbia River Spring Chinook Salmon," was also made available in 1978.

Male Breeding
Atlantic Salmon

Columbia River Genetic Identification Study Continues in Washington and Oregon

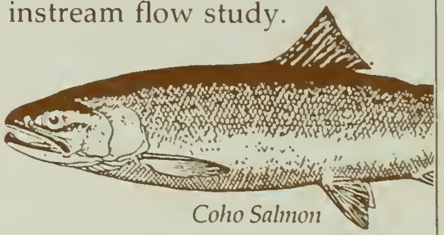
During 1978, nearly all the Columbia River Basin salmon and steelhead stocks were sampled as part of the continuing Columbia River Genetic Identification Study, a cooperative effort between the Fish and Wildlife Service and the National Marine Fisheries Service. Samples were collected from all hatchery stocks of steelhead and chinook, as well as from 23 wild stocks. Nearly 6,000 fish samples were analyzed by the electrophoretic process in order to identify Columbia River anadromous fish stocks by biochemical genetic markers and develop a computer (model) program to estimate the contribution of separate populations to mixed stock fisheries. A final report on this part of the study will be prepared in 1979. In the next phase, fish samples from all major chinook stocks in California streams will be collected and analyzed.

Assistance Continues on Warm Springs Indian Reservation in Oregon

In FY 1978, investigations continued into the biological, life-history, and run-timing characteristics of adult and juvenile chinook salmon and steelhead trout populations on Warm Springs Indian Reservation. Data collected in the ongoing study were used in designing the operational plan for the Warm Springs National Fish Hatchery and will continue to be used for fishery management decisions concerning the Warm Springs River and the hatchery. The two main tributaries of the Warm Springs River, Beaver Creek and Mill Creek, were surveyed to determine species composition and juvenile chinook salmon rearing areas. Resident rainbow trout populations in the river were also studied to evaluate possible impacts on them caused by releases of hatchery-reared anadromous species that compete with trout for food and space.

Study Completed on Skokomish River, Washington

A study on the instream flow of the Skokomish River was initiated and completed by fishery assistance personnel in FY 1978. The crucial portion of the study concerned the North Fork of the Skokomish. A special report describing results and predictions of optimum flows for salmon and steelhead by life stage was prepared and reviewed. Instream flows were measured by an incremental methodology which was developed by the Service's Instream Flow Group at Ft. Collins, Colorado. In addition, technical and cost estimation information was provided to Ecological Services for planning of the Skagit River Study Proposal. This study proposal will be reviewed by the Washington Departments of Fish and Game prior to its implementation. The two State departments will also review the Skokomish River instream flow study.



Coho Salmon

Benthic Organisms Studied in Commencement Bay

In FY 1978, the fishery resources staff at Olympia, Washington, conducted a qualitative investigation of benthic invertebrates in a proposed intertidal dredging site in Commencement Bay. The proposed site was located in the Port of Tacoma and had been used as a log-rafting site. Core samples were collected at several tidal heights and representative substrate types. Several benthic invertebrates important in the diet of salmonids appeared in relatively large numbers. A report entitled "An Examination of the Smaller Benthic Invertebrates in Hylebos Waterway, Tacoma, Washington" was prepared at the end of the study.

Pacific Herring Surveyed

A report prepared by the Olympia, Washington fishery assistance staff, covering three years of work on Pacific herring in Puget Sound, was completed in 1978 and distributed to State and Federal resource agencies and northwest Indian tribes. The report, entitled "Puget Sound Herring Surveys, Including Observations of the Gulf of Georgia Sac-Roe Fishery, 1975–77," contains an analysis of the status and commercial harvest potential of Puget Sound herring stocks, as well as timing and location of spawning beaches. Findings of the report indicate that no new fisheries are warranted. Also included are recommendations to reduce the size of the sac-roe fishing fleet in the Gulf of Georgia.

Feasibility of Harvesting Pacific Lamprey Tested

At the request of the Columbia River Inter-Tribal Fish Commission, fishery assistance personnel conducted a feasibility study of methods for harvesting lamprey in the Columbia River during FY 1978. The objective was to develop a technique of harvesting lamprey from dams or fish ladders. A thorough literature search of capture methods for Pacific lamprey (*Entosphenus tridentatus*) was completed prior to the field work. Seven trap designs, a trawl, and a tow net were tested. Although traps were tested at 106 different sites, only eight lamprey were caught. No feasible harvesting method was found. The final report will make several recommendations for subsequent studies of this type.

White Sturgeon Studied

The Vancouver fishery assistance staff continued to study white sturgeon populations in Bonneville, The Dalles, and John Day pools of the Columbia River. These reservoirs, formed by hydroelectric dams, lack the free-flowing water characteristics of white sturgeon habitats previously studied. In 1978, collection of life-history data from the Bonneville Pool white sturgeon population was completed. Data were obtained from 2,800 sturgeon, 2,759 of which were double tagged and released back into the pool. Length-weight measurements and bone samples were taken from selected fish for age analysis. With the cooperation of sturgeon fishermen and various fishery agencies, recapture data were recorded for 168 sturgeon. Bonneville Pool data are presently being analyzed and a final report will be prepared during FY 1979. Tagging operations on The Dalles Pool have already begun.

Atlantic Salmon Restoration Planning Continues

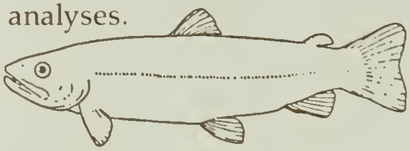
A major effort is underway in the New England States to restore and enhance populations of Atlantic salmon (*Salmo salar*) in major river systems including the Connecticut, the Merrimack, the Pawcatuck, and selected rivers in Maine. The New England Atlantic Salmon Restoration Plan consists of four unique subplans for the development and maintenance of salmon populations. In FY 1978, the draft Strategic Plan for the Merrimack River Basin was completed and accepted by the participating resource agencies. It is being reviewed by Federal and State agencies, Canadian biologists, and by private organizations. The draft plan for the Connecticut River is nearly complete, and the first step in preparing the strategic plan for Maine rivers has begun.

Mad River Salmon Productivity Studied

In FY 1978, fishery assistance personnel in Vermont and New Hampshire completed the third year of the Mad River Atlantic salmon productivity study. Young Atlantic salmon were sampled periodically with electrofishing gear to measure growth, survival, and food habits and outward migration.

Radio-Tagged Smolt Migration Studied in New Hampshire

Fishery resources personnel radio-tagged 100 Atlantic salmon smolts released into the Merrimack River in FY 1978 to track their movements in the river system. The principal movement of all migrating smolts was in the deep channel areas between dusk and midnight. Water temperature did not appear to influence timing or rate of migration, but increased river flows markedly influenced movement. Smolts were tracked in the Pawtucket Canal System and in the estuary between Merrimack and Newburyport. Several smolts stocked in 1977 were collected and sent to laboratories for pesticide and heavy metal analyses.



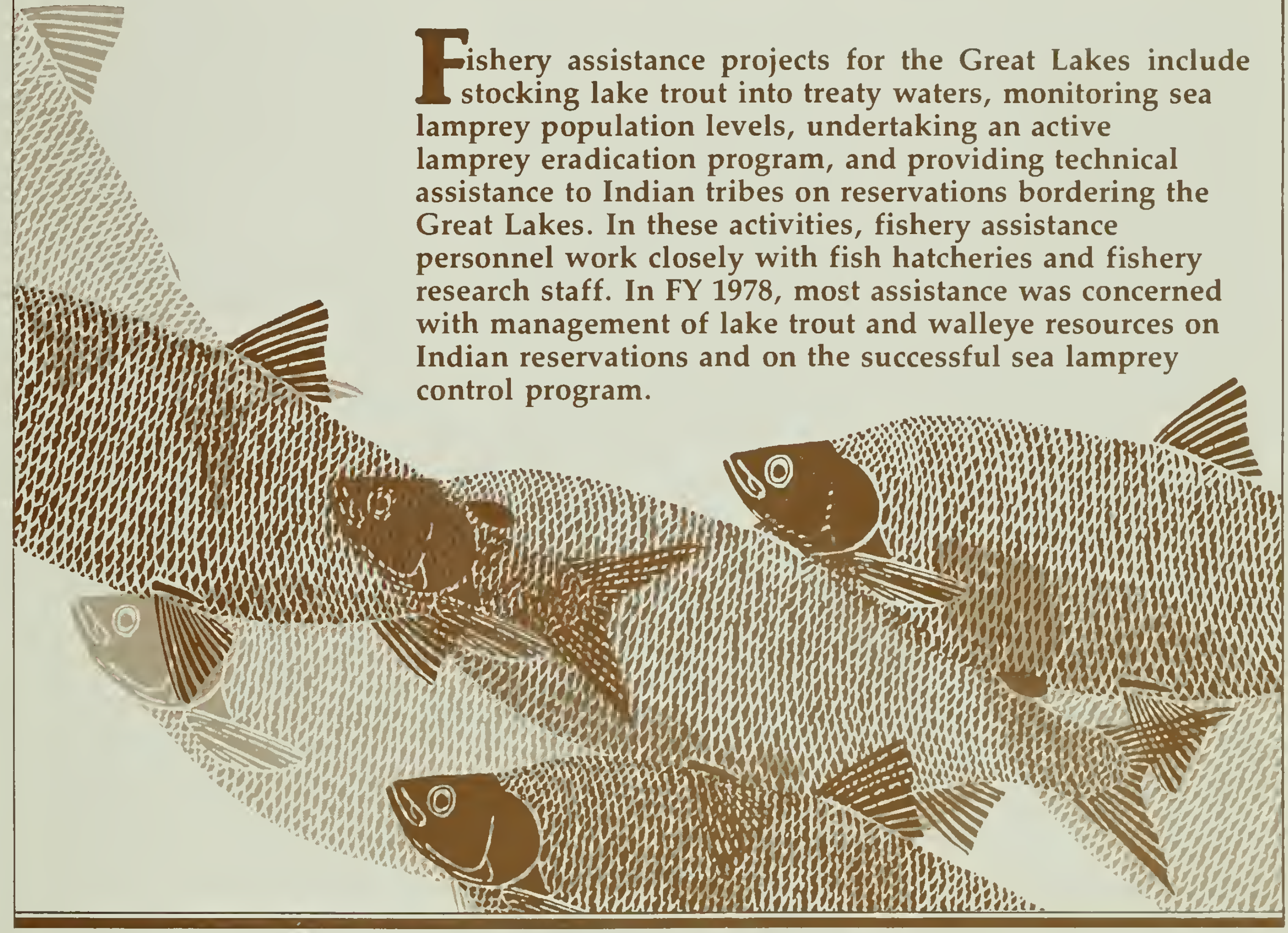
White River Atlantic Salmon Studied

Investigations by fishery assistance staff in Montpelier, Vermont, continued for the seventh year on Atlantic salmon in the White River of Vermont, a Connecticut River tributary. The objectives of this continuing study are to determine Atlantic salmon growth and survival as influenced by prevailing habitat conditions, timing and quantity of smolt outmigration from the study area, and population structure changes within and between resident fish species such as trout. In FY 1978, approximately 50,000 Atlantic salmon fingerlings were stocked in three White River tributaries in pre-selected juvenile habitats. Sampling studies show that significant numbers of salmon are leaving the tributaries in which they were stocked and spending part of their juvenile life cycle in the White River.

New Emphasis Placed on Hybrid Bass

A new project design for the Apalachicola River study begun in 1976 places major emphasis on the *Morone* hybrid (white bass male x striped bass female). Hybrids have been stocked in area waters since 1975. In FY 1979, fishery resources field biologists will conduct a non-uniform probability creel census in a cooperative effort with the State of Florida to gain additional information on the status of *Morone* hybrids and striped bass and to determine the direction of future management plans. The information obtained should be useful throughout the Southeast where there is strong interest in both the striped bass and the hybrid.

FISHERY·ASSISTANCE
GREAT·LAKES·FISHERIES



Fishery assistance projects for the Great Lakes include stocking lake trout into treaty waters, monitoring sea lamprey population levels, undertaking an active lamprey eradication program, and providing technical assistance to Indian tribes on reservations bordering the Great Lakes. In these activities, fishery assistance personnel work closely with fish hatcheries and fishery research staff. In FY 1978, most assistance was concerned with management of lake trout and walleye resources on Indian reservations and on the successful sea lamprey control program.

Assistance to Indian Tribes Continues

A high priority for fishery assistance personnel in the Great Lakes region is providing technical fishery management assistance to Indians. During FY 1978, this assistance included fish population assessment and manipulation, habitat survey and development, training of tribal members in resource management, and advice and assistance with resource planning and regulation. Assistance is directed toward development of tribal expertise so that tribes will eventually be able to take over complete management responsibilities for resources on the reservation. The level of assistance to tribes, however, may be greatly affected by the resolution of Indian hunting and fishing claims presently under litigation.

Walleye Spawning Managed

Fishery resources personnel continued to provide assistance to the Bad River Indian Reservation in northern Wisconsin during FY 1978. Assistance was given primarily to management of walleye spawning runs in the Bad and Chequamegon Rivers, whose runs support the walleye population in the Chequamegon Bay area of Lake Superior. Fish sampling data for walleye from the Bay showed that the 1978 year class was more abundant than the 1977 year class. The increase in abundance of young of the year in 1978 may be attributed to the operation of the Bad River tribal walleye hatchery and the stocking of more than 200,000 walleye produced by national fish hatcheries.

Efforts to Establish Chinook Run Continue

Fishery assistance personnel at Bemidji, Minnesota, continued their efforts in a 3-year experimental program to establish a chinook salmon run on the Grand Portage Indian Reservation. This program, carried out in cooperation with the Minnesota Department of Natural Resources, is part of an effort to increase the sport fishery opportunity in Lake Superior waters near the Grand Portage Reservation.

Lake Trout and Whitefish Management Planned

Technical review and advice was provided in 1978 to several Indian tribes on management of lake trout and whitefish in Indian treaty waters of the Great Lakes. Meetings held among various tribes, State fish and game agencies, and Service personnel in an effort to resolve management and fishing conflicts in the Great Lakes resulted in a fishery management plan for Whitefish Bay of Lake Superior. The plan's primary purpose is to provide management guidelines for the Bay Mills Tribe of Lake

Chinook Salmon

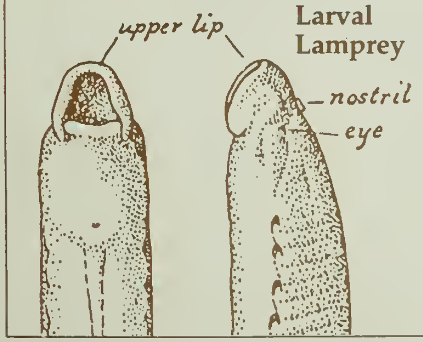
Superior Band of Chippewa Indians in their commercial fishing operations for lake trout and whitefish. The plan will be reviewed and revised as required annually.

Fishery assistance personnel stocked over 100,000 lake trout in waters claimed by treaty Indians in Whitefish Bay of Lake Superior after the State of Michigan ceased stocking lake trout in this area. This was done under the Secretary of the Interior's Indian trust responsibilities. The Coast Guard assisted in stocking Whitefish Bay lake trout on offshore reefs. The Fish and Wildlife Service has also been investigating the possibility of implementing a cooperative program with the Coast Guard that would result in stocking nearly all lake trout in offshore areas.

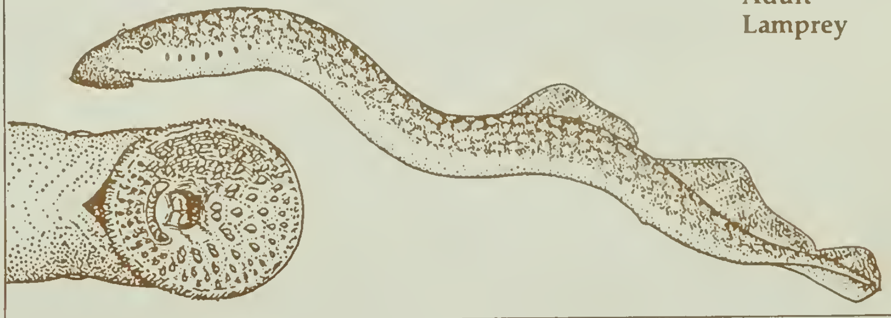
Sea Lamprey Control Programs Continue to Succeed

The Great Lakes Fishery Commission has responsibility for the control of sea lamprey in the Great Lakes Basin and contracts with the Fish and Wildlife Service to perform control activities. This program aims to reduce the sea lamprey population in the Great Lakes to a level where it no longer limits the restoration of recreational and commercial fisheries in the Great Lakes.

In FY 1978, surveys to assess sea lamprey populations were conducted on 312 streams tributary to the Great Lakes. Sea lamprey larvae were found for the first time in six streams. Because of the pollution abatement activities taking place in the Great Lakes, stream habitat has improved and many streams now support lamprey populations that would not do so in the past. The number of adult sea lamprey captured at eight index barriers on Lake Superior in 1978 was nearly identical to last year's catch and was again below the average for the past 10 years. Excellent progress was made in the application of lampricides to streams to destroy larval sea lamprey. Chemical treatments were completed on 46 tributaries of Lakes Superior, Michigan, and Huron. A detailed report on sea lamprey control activities, "Interim Report on Sea Lamprey Control to the Great Lakes Fishery Commission," was completed this year.



Larval Lamprey



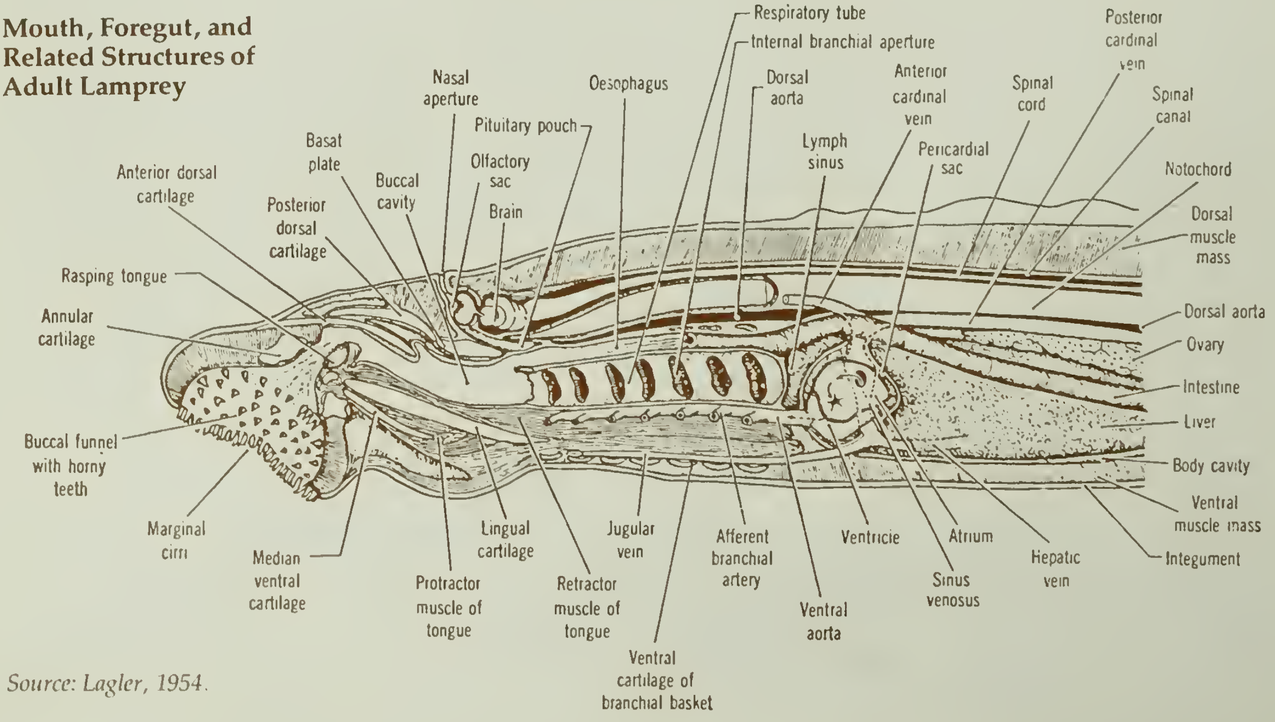
Adult Lamprey

Lamprey Populations in Lake Champlain Assessed

During FY 1978, fishery resources personnel continued sea lamprey nest-count surveys on four Lake Champlain tributaries in New York and Vermont, and began a survey on Putnam Creek. The nest-count survey results show the number of nests to be down about 50 percent compared to 1977. First-year records for Putnam Creek showed 780 nests in 2.5 miles of stream. During the nest counts, 131 live and 17 dead adult sea lamprey were observed in Putnam Creek.

Electrofishing surveys for sea-lamprey ammocoetes were done on 16 tributaries of Lake Champlain. Ammocoetes were collected for the first time in five streams and were again found in Lewis Creek, Vermont, and Putnam Creek, New York. Fyke-netting surveys conducted on these seven streams resulted in the capture of 170 transforming sea lamprey adults that were intercepted on their downstream migration to Lake Champlain. Fishermen were also surveyed to identify sea lamprey damage to their catches of Lake Champlain salmonids. Of the fish examined, sea lamprey damage was evident on lake trout (75 percent), landlocked Atlantic salmon (90 percent), and on steelhead and rainbow trout (58 percent).

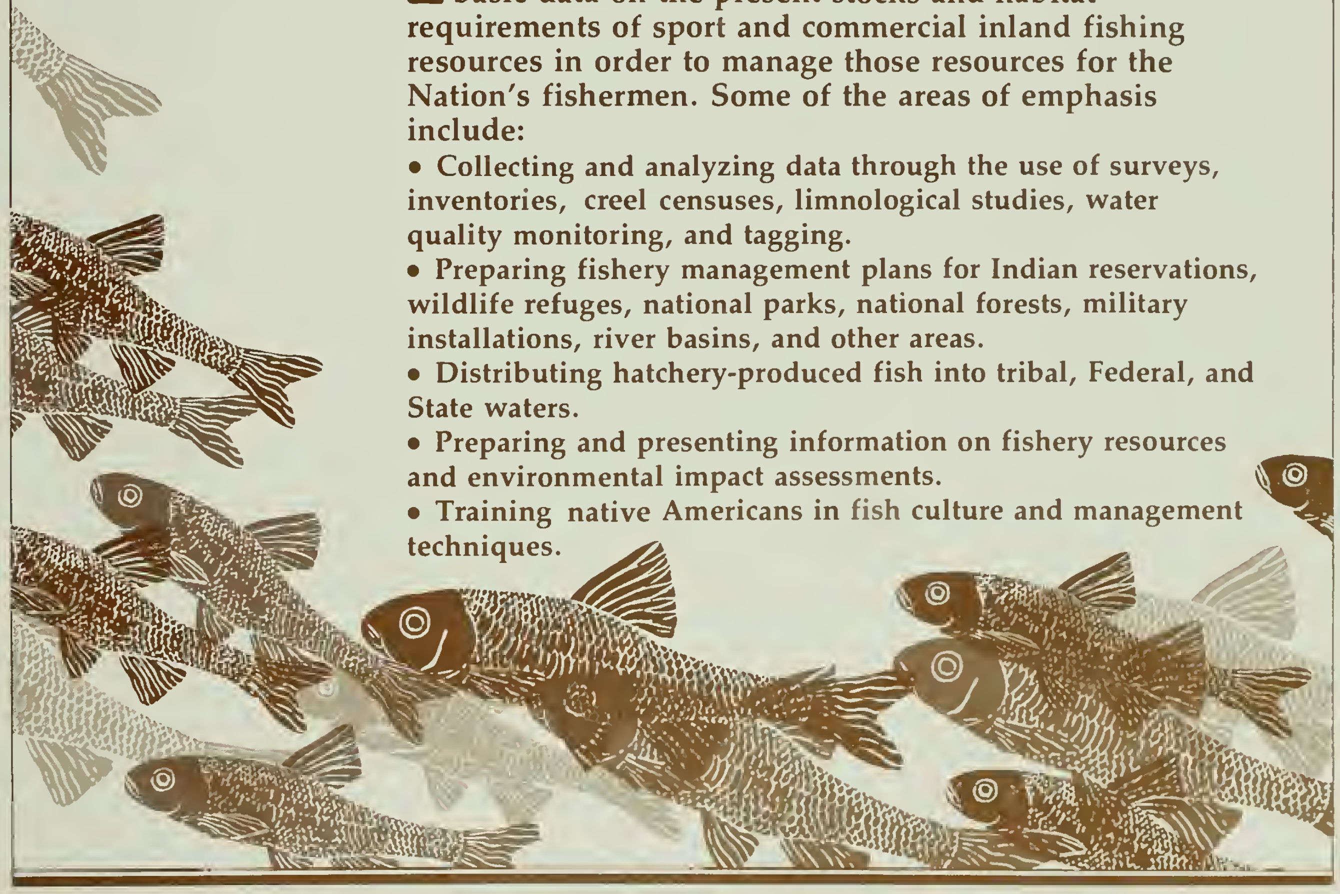
Mouth, Foregut, and Related Structures of Adult Lamprey



Source: Lagler, 1954.

Fishery assistance activities on inland fisheries provide basic data on the present stocks and habitat requirements of sport and commercial inland fishing resources in order to manage those resources for the Nation's fishermen. Some of the areas of emphasis include:

- Collecting and analyzing data through the use of surveys, inventories, creel censuses, limnological studies, water quality monitoring, and tagging.
- Preparing fishery management plans for Indian reservations, wildlife refuges, national parks, national forests, military installations, river basins, and other areas.
- Distributing hatchery-produced fish into tribal, Federal, and State waters.
- Preparing and presenting information on fishery resources and environmental impact assessments.
- Training native Americans in fish culture and management techniques.



FISHERY · ASSISTANCE
INLAND · FISHERIES

Assessment of Alaskan Reservation Fishery Completed

Fishery assistance personnel completed an assessment of the Tyonek Indian Reservation's potential for developing a profit-oriented sport fishery in FY 1978. The assessment, begun at the request of the Tyonek Tribal Council, covers nine lakes and 6 miles of streams on the reservation. Lake survey methods used included gill netting to find the abundance and variety of resident and anadromous fish, analyses of plankton populations to determine the quantity of fish food, and chemical analyses to assess water quality. Weirs were set in streams to count and determine the timing of salmon spawning runs, and stream gravel was evaluated to ascertain spawning potential. Economics and esthetic factors were compared to other areas of Alaska.

Inventory surveys indicated that the Tyonek Indian Reservation possesses valuable fishery resources. A number of lakes had good rainbow trout populations and individual streams historically or currently supported low runs of single or multiple species mix of pink, sockeye, and coho salmon. Economic comparison indicated that the reservation's fishery resources were probably not currently competitive with those in other areas of Alaska where access is easier and less expensive. Therefore, it was recommended that no large-scale fishery management measures be undertaken at this time. A final report of survey results and fishery management recommendations was presented to the Tyonek Tribal Council in 1978.

Studies Begin on Colorado Reservation

A special study of the Parker Diversion of the Colorado River was initiated in FY 1978 on the Colorado River Indian Reservation in Arizona. An extensive creel census of the Parker Diversion was conducted by a YACC student in a coordinated effort among the Fish and Wildlife Service, the tribes, and the California Fish and Game Department. In addition, a draft fishery management plan for the reservation was completed in 1978. The Colorado River Indian Reservation includes about 317 acres of lakes, 395 miles of canals and drains, and 57 miles of the Colorado River. This year fishery assistance to the reservation included stocking of 30,800 rainbow trout and 24,155 channel catfish in reservation waters.

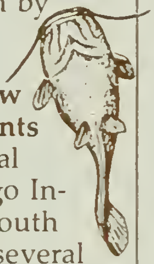
Populations of Arizona Trout Surveyed

Fishery assistance efforts to reestablish the Arizona trout (*Salmo apache*) in lower Ord Creek (from the upper to the lower barrier) on the Fort Apache Indian Reservation, Arizona, were temporarily stopped this year after an intensive electrofishing survey revealed that brook trout were the only fish species inhabiting the creek above the Smith Cienega barrier and only brook and brown trout were found between the two barriers. The absence of Arizona trout indicates that the creek must be renovated again in FY 1979 to remove all exotic species and thus allow for the reintroduction of Arizona trout. Two populations of possibly pure

Salmo apache were located on Smith and Bear Cienega Creeks on the reservation and these fish may be transferred to Ord Creek for repopulation.

Water Flow a Problem on Arizona Reservations

Fishery assistance to the Fort McDowell and the Salt River Indian Reservations in Arizona has primarily involved stocking catchable rainbow trout to produce a winter fishery in the Verde and Salt Rivers. During 1978, both reservations began to plan for greater participation in their fishing programs. Fishery resources personnel met with the Fort McDowell Planning Committee in an effort to plan future programs. The foremost problem with maintaining a fishery on these two reservations is the unsure water situation. The Salt River Project controls flows in both the Salt and the Verde Rivers from upstream storage facilities; at times, there is no water to support a fishery in either channel. Both reservations are also far from trout hatcheries and distribution of hatchery fish to these reservations is difficult. Fishery resources staff have suggested construction of fish-holding facilities on the reservations to provide easier distribution of fish by tribal personnel.

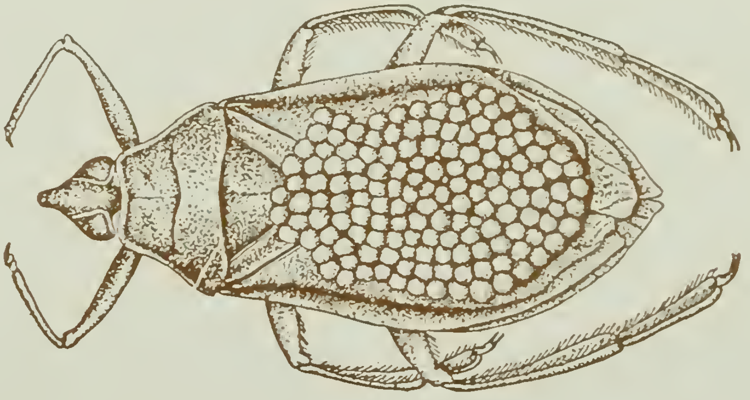


Channel Catfish Grow Well in Impoundments

There are no perennial streams on the Papago Indian Reservation in south central Arizona, but several man-made impoundments are stocked by fishery resources staff each year. Fingerling channel catfish and largemouth bass were stocked in these 10-meter-deep, funnel-shaped catchment basins–called charcos—in FY 1978. Population surveys conducted during 1978 showed that large channel catfish (3–5 pounds) can be grown in charcos without the benefit of forage fish or plant cover. Forage fish will be introduced into selected charcos in the future and their effect assessed.

Commercial Fishery at Red Lake Indian Reservation Expands

The Red Lake Indian Reservation in Minnesota receives fishery assistance in the management of its commercial fishery, an experimental trout production study, and maintenance of recreational fishing. In FY 1978, commercial production at Red Lake exceeded a record 2 million pounds, of which 650,000 pounds were walleye and 550,000 pounds were yellow perch.



Walleye Fishery Established on Reservation

An effort to establish a walleye fishery on one lake on the Menominee Indian Reservation in Michigan was successful in FY 1978. Fishery assistance sampling results this year showed that walleye stocked in 1976 have grown to about 20 inches in length as compared to an average for the area of 13 inches. Five members of the Menominee Tribe were trained by fishery assistance personnel in conducting fish population inventories through a program funded by the Comprehensive Education and Training Act (CETA). The tribe will soon be able to take over the management of its own fish and wildlife resources.

Temperature Changes Cause Walleye Egg Mortality

In FY 1978, fishery resources staff worked with tribal hatchery personnel at the Bad River Indian Reservation, Wisconsin, to determine the cause of unusually high mortality of walleye eggs. Preliminary findings indicate that egg loss is related to uncontrolled temperature fluctuations in water pumped into the hatchery from the Kakagon River. The Kakagon River has a natural back-and-forth flowing action that affects water temperature with each change.

Pollution Control Plan Prepared with Blackfeet Tribe

During FY 1978, fishery resources staff cooperated with the Blackfeet Tribe to pinpoint water pollution problems and gather baseline water-quality information from each of the major stream systems on the Blackfeet Indian Reservation in Montana. This work was done under an agreement with the tribe to compile a Section 208 Federal Water Pollution Control Act Plan with initial funding from the Environmental Protection Agency. Public hearings were held throughout the 1,525,000-acre Blackfeet Reservation to determine the desires and problems of local citizens. The final plan will be completed in FY 1979.

Wind River Indian Reservation Assisted

Fishery assistance to the Arapahoe and Shoshone Indian Tribes on the Wind River Reservation, Wyoming, during FY 1978 included conducting basic resource and habitat inventories of high mountain lakes and evaluating and improving the interim management plan for the reservation. Because data on the fish and wildlife resources of the reservation are lacking, most effort was expended on the inventories and surveys. Procedures were determined for minimizing fish habitat damage resulting from maintenance of irrigation facilities, and a preliminary investigation of the environmental impacts of a dam at Raft Lake was undertaken. In addition, fishery assistance personnel have developed plans for providing the tribes and the BIA with the projected relationships between stream flow and fish, waterfowl, and furbearer habitat in an effort to provide evidence for use in a legal dispute over the water in the Big Horn River system.

Mineral Exploration on Washington Indian Reservations Begun

During 1978, the Colville Confederated Tribes and Amax, Inc., a multinational mining corporation, signed an agreement to explore, and if commercially feasible, to mine the copper-molybdenum deposit on Mount Tolman. Test drilling for quantitative prediction began in the fall and initial results are very promising. If feasible, ore extraction could result in operation of a large mine-tailing pond approximately 2 miles from Lake Roosevelt. This operation poses the threat of contamination of the lake and the Columbia River with molybdenum, copper, and other heavy metals. Fishery resource personnel, in response to this possibility, began baseline analyses for heavy metals in representative fish species in Lake Roosevelt in 1978.

Assistance to Metlakatla Indians Phased Out

Fishery resources personnel have assisted the Metlakatla Indians on Annette Island Indian Reservation in Alaska with the development and management of their anadromous and inland fisheries since 1971. The Indians accepted responsibility for managing their own anadromous fishery in 1976. Assistance since then has primarily focused on collecting baseline data for developing an inland fishery management plan. In FY 1978, data were organized and analyzed and a final report prepared. The report, which includes inventory survey results and general recommendations for evaluating and maintaining the resource, will be submitted to the Indian community in 1979. This will mark the end of direct assistance to Annette Island Reservation.

Seminole Tribe Continues Aquaculture Project

Fishery resources personnel continued their assistance to the Seminole Tribe of southern Florida in FY 1978. The Seminole tribal lands consist of three reservations. Nearly all of the sport fishing on these lands occurs in an extensive network of large flood-control canals and a few small borrow pit ponds. The tribe operates a commercial catfish farming facility known as the Seminole Aquaculture Project that is funded by the U.S. Economic Development Administration and the State of Florida. Six Seminole Indians who have received both formal and on-the-job aquaculture training are investigating the feasibility of raising and processing channel catfish for food fish markets. A modern fish-processing plant was constructed during the year and should become fully operational in FY 1979. Construction of two batteries of concrete fish-holding tanks was completed during the year, and construction of two large ponds was also begun. Present tribal plans call for the eventual development of up to 200 surface acres of ponds to be used for the sole purpose of producing marketable catfish.

Assistance to North Carolina Indian Reservation Continues

The Cherokee Indian Reservation in North Carolina contains 30 miles of trout streams and three ponds which are managed for rainbow, brook, and brown trout fisheries. Non-Indians are allowed to fish in these waters for a fee.

Fishery assistance to the Cherokee Indian Reservation in North Carolina in FY 1978 included a full-time creel census using YACC enrollees. The census indicated that the fishing program on the reservation sustained approximately 54,000 trips during the 1978 season (April-October). Twenty-two streams were also sampled to determine species of fish present and their respective contribution to the standing crop. Information of this type is needed for all streams on the reservation.

Assistance Given to Oklahoma Military Installations

During 1978 fishery resources staff provided assistance to the Fort Sill Missile and Artillery Center. Data on many of the Fort Sill ponds are out of date and new lake surveys are needed to update their fishery management plan.

On the Tinker Air Force Base, aquatic surveys were conducted on three ponds to determine fish populations, limnological conditions, and fishing pressure. Partial rotenone treatments and spot applications of herbicide were made by fishery assistance personnel to control aquatic vegetation.

Trout Stocking Evaluated in Air Force Base Lake

Fishery assistance personnel discussed preliminary planning for the implementation of a put-and-take trout stocking evaluation with personnel from the Wright-Patterson Air Force Base, Ohio, during 1978. Gravel Lake, an impoundment covering six surface acres, was selected for the evaluation. This lake is stocked annually with 8,000 rainbow trout from the Bowden National Fish Hatchery.

Cooperative Efforts Clean Up Lake

A lake of 16 surface acres on the Chanute Air Force Base, Illinois, recreation area was renovated and restocked during 1978. Fishery resources personnel were assisted in implementing the project and cleaning up dead fish by other Service groups, Air Force personnel, Youth Conservation Corps (YCC), and YACC enrollees. Approximately 5,000 fish—primarily gizzard shad and carp—were removed.

Trout Stocking in Refuge Appears Successful

In 1978, informal creel checks of experienced trout fishermen were made by fishery assistance personnel on Devils Kitchen Lake at Crab Orchard National Wildlife Refuge in Illinois. The fingerling rainbow trout stocking program appears to be extremely successful, with trout up to 2.8 pounds being caught by fishermen. A formal creel census is planned for FY 1979. In addition, standardized electrofishing sampling was initiated this year with timed runs through designated areas, and a partial creel census was taken on Crab Orchard Lake in FY 1978.

Assistance to Refuges in New Mexico Continues

The Bosque del Apache National Wildlife Refuge (NWR) and the Bitter Lake NWR are located in arid re-

Fishery assistance personnel sample fish populations and renovate lakes by applying rotenone, a fish poison.

gions that have little public fishing opportunity and thus meet a critical recreational need. Bitter Lake NWR experienced gradual increases in angler usage and the fishery program was a high priority in FY 1978. Low water levels and excessive minerals (especially at Bitter Lake) preclude development of a self-sustaining sport fishery in either of these refuges.

Restoration of Lake on Wildlife Refuge Completed

Piedmont NWR in Georgia is operated as a demonstration project to illustrate how fish and wildlife can be produced in a managed forest. Fishery resources assistance to the refuge consists of renovation and restocking of the 11 ponds on the refuge. Most of these ponds have been renovated within the last two years, with renovations staggered to provide some fishing at all times. Ponds renovated in previous years were sampled by seining and found to contain excellent populations of catchable largemouth bass and bluegill.

Collected fish are measured, weighed and scale samples are checked for age and growth statistics.

Fishery Assistance Reinstated After Five-Year Lag

Historically the Federal and Indian lands in the States of Iowa, Missouri, and Kansas have received little technical fishery assistance. During FY 1978, new assistance programs for the area were initiated and included field surveys of Indian reservations, national wildlife refuges, Veterans' Administration hospitals, and military installations. Technical assistance was provided to the Kickapoo and Potawatomi Indian Reservations for the very first time. Preliminary work on the DeSoto Lake in DeSoto NWR was also begun. Data collected on the refuge included physical and biological inventories, habitat improvements, fishing regulations, and fish stocking.

Fishery resources staff are developing a fishery management plan for the refuge. The Iowa and Missouri Cooperative Fishery Units also provided advice and assistance.

Egg Yield Down on Valentine National Wildlife Refuge

Fishery resources personnel manage northern pike populations on the Valentine NWR in Nebraska for their yield of eggs to State and Federal hatcheries. Usually 30 million northern pike eggs are collected annually from this refuge. This year, however, northern pike spawned while ice still covered collection areas, and only 10 million eggs were collected. During FY 1978, a fishery management plan for the refuge was completed. The plan provides for annual yields, by 1985, of 40 million northern pike eggs, 20 million muskellunge eggs, and 100 replacement brood bass to be taken from the refuge waters.

Carp Controlled in Lake Malheur, Oregon

Fishery resources personnel assisted in the planning, application, and pre- and post-evaluation of the rotenone application to Lake Malheur, located within the confines of Malheur NWR during FY 1978. This program was carried out to reduce or eliminate the extensive carp populations that were deemed responsible for dramatic reduction of sago pond weed. Reports from Malheur personnel indicate a return of extensive beds of sago pond weed throughout the area.

DRAGON-FLY *(Nymph)*

Brook Trout Recovery Efforts Begin in National Park

Although fish have not been stocked in the Great Smoky Mountains National Park since 1975, Fishery Resources staff are involved with the protection of the native brook trout *(Salvelinus fontinalis)*. While this species is not on the Federal list of threatened and endangered species, it is endangered in this park. Past stocking of rainbow trout and logging operations are thought to have reduced brook trout populations, and recovery operations were initiated in FY 1978. Work began to remove rainbow trout from areas where both fish are present, specifically between falls. The falls serve as natural barriers to prevent reintroduction of undesirable fish. Evaluation of the areas will begin after approximately 12 stream miles have been renovated.

Surveys Begin on Blue Ridge Parkway

Fishery Assistance to the Blue Ridge Parkway during 1978 involved surveys to determine the condition of the fisheries, define the range of the native brook trout, and provide an up-to-date list of fish species found in the parkway. As a result of meetings held during the year, work by biologists in the Virginia and North Carolina portions of the parkway is now coordinated. Positive identification of fishes is being provided by taxonomists from the University of Tennessee. A total of 40,600 trout were stocked into streams on the parkway during the year.

Fishery Investigations Begin in Glacier National Park, Montana

Fishery management investigations in Glacier National Park began in FY 1978 as a result of a formal agreement drawn up between the park and the Fish and Wildlife Service during 1976. Fishery assistance personnel established seven stations within the Middle Fork Flathead River watershed for habitat and fish population monitoring. Four fishery habitat cross sections were also analyzed for park waters within the North Fork Flathead River watershed. Habitat sections are evaluated in respect to fish populations, aquatic insects, water quality, stability, esthetics, and numerical rating of the stream's physical habitat. All investigations within Glacier National Park are coordinated with the park's aquatic biologist and the Montana Fish and Game Department.

Management Continues in Yellowstone Park Waters

Fishery assistance in Yellowstone National Park includes providing study and advice on maintenance and restoration of aquatic environments and native fish populations, creating fishing regulations that will assure high-quality angling, and encouraging visitor participation in preserving native species. In FY 1978, work included the operation of weirs and traps in Pelican, Clear, and Cub Creeks to enumerate both the upstream and downstream runs. The exotic longnose sucker spawning run of Pelican Creek was destroyed for the third consecutive year, and Yellowstone Lake was sampled to evaluate effects of regulation changes, population trends, and sucker destruction. A limnological study to evaluate the effects of the 1976 divide fire on the South Arm of Yellowstone Lake was continued with biweekly sampling and data analysis, and midwater trawling gear was tested to develop a method of predicting year-class abundance in the lake in 1979. An additional 13 lakes in the back-country of the park were surveyed in FY 1978, bringing the total number of Yellowstone lakes with a baseline ecological profile to 115.

Management Activities Begin on National Forest

Of the 27 ponds on the Shawnee National Forest, Illinois, surveyed by fishery assistance staff in FY 1978, 19 were determined to be suitable for sport fishery management. Management activities at several of the sites included renovation, restocking, and maintenance stocking of channel catfish, and vegetation control. Fish population inventories were completed at six impoundments ranging in size from 20 to 120 surface acres, and a creel census was taken at two of these. Bluegill accounted for over 70 percent of the catch at both lakes.

Surveys Continue in Chugach National Forest

The U.S. Forest Service is developing comprehensive land management plans for its Alaska holdings, including Chugach National Forest. In FY 1978, fishery assistance staff assisted in stream habitat evaluation surveys in the forest on Upper Trail, Bench, Six Mile, Ptarmigan, and Big Indian Creeks and in Upper Trail and Russian Rivers. Information was collected on bottom type and gravel size, stream depth profiles, fish species present, bank and instream vegetation, and aquatic insect life.

Aquatic Resources Inventoried on White Mountain National Forest

Fishery resources staff assisted the U.S. Forest Service in updating the aquatic resource inventory on the White Mountain National Forest in New Hampshire during FY 1978. Status reports summarizing resource information and survey needs for ponds and streams on three planning units in the forest were completed and distributed. Additional surveys were completed for ponds and streams in two other planning units, and data were incorporated into the forthcoming management plans.

Evaluations were also done on the effects of ski area operation and development on adjacent streams in the forest. Impacts from Mount Tecumseh, Wildcat, and Loon Mountain ski areas were assessed. Poor construction practices at Mount Tecumseh and Loon Mountain caused a severe reduction of trout in the affected streams.

Kenai Moose Range Assistance Continues

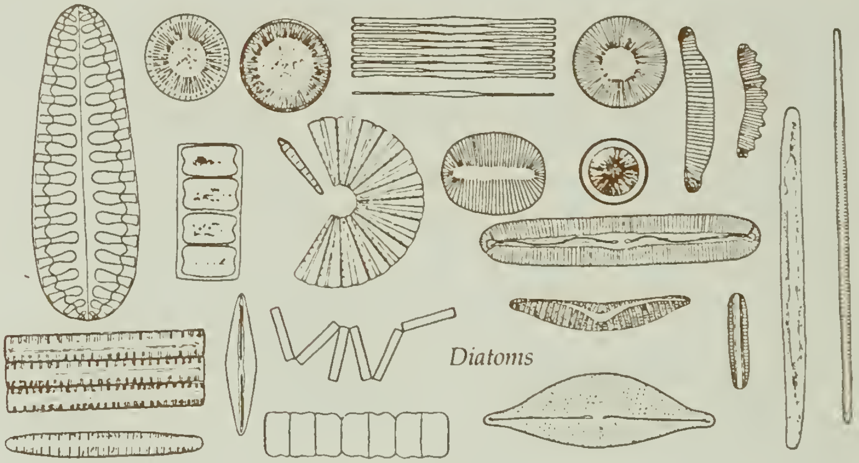
Fishery resources personnel at Kenai, Alaska, provided assistance in planning and carrying out aquatic resource investigations on the Kenai National Moose Range. In FY 1978, surveys were conducted on 14 lakes totaling 1,800 surface acres. Dissolved oxygen, pH, alkalinity, specific conductance, hardness, ice depth, snow depth, and water depth were recorded. Preliminary analysis of the data indicated that nine lakes were extremely infertile. Three lakes may have winter fish kills due to low concentrations of dissolved oxygen.

A weir for counting and identifying fish was constructed on the Swanson

River above its confluence with Cook Inlet. Information gathered indicated that only a small number of sockeye, coho, and pink salmon spawned in the river during the summer. Five additional streams surveyed provided salmon spawning and nursery areas and supported rainbow and Dolly Varden trout populations.

Truckee River Fishery Study Completed

Fishery assistance personnel at Reno, Nevada, completed data analysis for the 3-year Truckee River fishery study during FY 1978. These studies have shown that is is physically and biologically feasible to reintroduce natural spawning runs of Lahontan cutthroat trout in the river, but additional data will be necessary to evaluate salmonid competition and outmigration to reach conclusions and make final recommendations. An analysis is also under way that will give rough estimates of the size of the Lahontan cutthroat run in the early 1900's for comparison to recent artificial recruitment efforts under stable conditions.



Diatoms

Strip Mine Lakes Fishery Potential Evaluated

Fishery resources personnel at the Central States Fishery Station in Princeton, Indiana, have been involved in the investigation of the sport fishing potential and the development of fishery management techniques for waters created by surface coal mining. Memoranda of Understanding with the Old Ben and Peabody Coal companies provide access to study areas located in southern Indiana. In FY 1978, a 3-year fertilization study on strip mine lakes was completed. Four lakes—including two deep basin lakes and two shallow lakes—were stocked with largemouth bass, bluegill, redear sunfish, and channel catfish fingerlings in 1975. One deep and one shallow lake were selected for fertilization while the other two served as controls. Results from the first year indicated no significant variation in productivity between study sites. The four lakes were renovated in 1978 and total standing crop estimates show a mean increase of 119 pounds/acre of largemouth bass, bluegill, redear sunfish, and channel catfish in the two fertilized lakes. A final report has been prepared that includes evaluations of physiochemical parameters, zooplankton, phytoplankton, benthic organisms, and fish.

Rainbow Trout Evaluated in Field

In 1978, fishery resources personnel in Nebraska initiated a study to evaluate the field performance of different strains of catchable rainbow trout developed at the Fish Genetics Laboratory in Beulah, Wyoming. The average of four trials showed that the production strain held at Saratoga National Fish Hatchery, Wyoming, returned 73 percent to the creel, while the strain developed at the Fish Genetics Laboratory (Sand Creek × Spring Standard) returned 95 percent.

Ohrid Trout Study Curtailed

A loss of fishery assistance personnel curtailed further cooperation with the State of Tennessee in following through with the planned study of Ohrid trout (*Salmo letnica* Karaman) in the Watauga Reservoir. Ohrid trout, a deep-lake Yugoslavian species, are being cultured at the Erwin National Fish Hatchery, Tennessee. Three age groups of Ohrids were tagged and released in FY 1978, and many of these fish have subsequently been caught. Creel census and tag returns indicate that this species is well suited for deep coldwater lakes as indicated by exceptional survival and growth.

Rainbow Smelt in Lake Champlain Investigated

Fishery resources staff began field operations in Lake Champlain to investigate smelt spawning activities in FY 1978. Gill netting under the ice began in Lewis Creek, Vermont and smelt were collected as far as one-half mile upstream from the lake. Although the adult smelt collected appeared to be in prespawning condition, it was felt that their movement into the river was more of a feeding migration than a spawning migration. After ice left Lewis Creek, special smelt dip nets were used, but no smelt were collected. Gill netting in the early spring in Lake Champlain resulted in the collection of large numbers of smelt in prespawning condition. A spawning area was located by using a sled dredge to collect eggs. Examination of the dredge samples showed that smelt egg deposition appeared to be confined to depths of 30 to 90 feet in the lake—a totally different pattern than was expected for the species. In most lakes which have smelt populations, spawning occurs along shorelines or in feeder streams. This marked the first positive identification of a spawning locale for rainbow smelt in Lake Champlain.

Snake River Cutthroat Trout Evaluated

In FY 1978, fishery resources personnel in the Denver, Colorado, area stocked Snake River cutthroat trout into small reservoirs in the shortgrass prairie habitat to determine their performance as a trout fishery. Cutthroats were monitored after stocking for survival and growth. Growth was reduced in those reservoirs having yel-

cutthroat trout

low perch populations, but overall the cutthroats survived well and returned to the creel early in the season. Much of the success of this fish may be due to its use of any feed available, particularly fathead minnows. Snake River cutthroats as small as 6 inches were found to be feeding on the minnows.

Greenback Cutthroat Trout Recovery Activities Continue

The fishery assistance staff in Lakewood, Colorado, are the Fish and Wildlife Service representatives on the Greenback Cutthroat Trout Recovery Team. One of the objectives of the team is to reestablish the cutthroat into waters on the Rocky Mountain National Park. Three populations of greenbacks have been introduced into the park since 1970. Surveys conducted in FY 1978 show that a cutthroat population has established itself in the North Fork of the Big Thompson River. Another population has established itself and reproduced in Hidden Valley Creek. Brook trout were removed from the creek prior to reintroduction of the cutthroats, but unfortunately some remain and compete for food and space with the greenbacks.

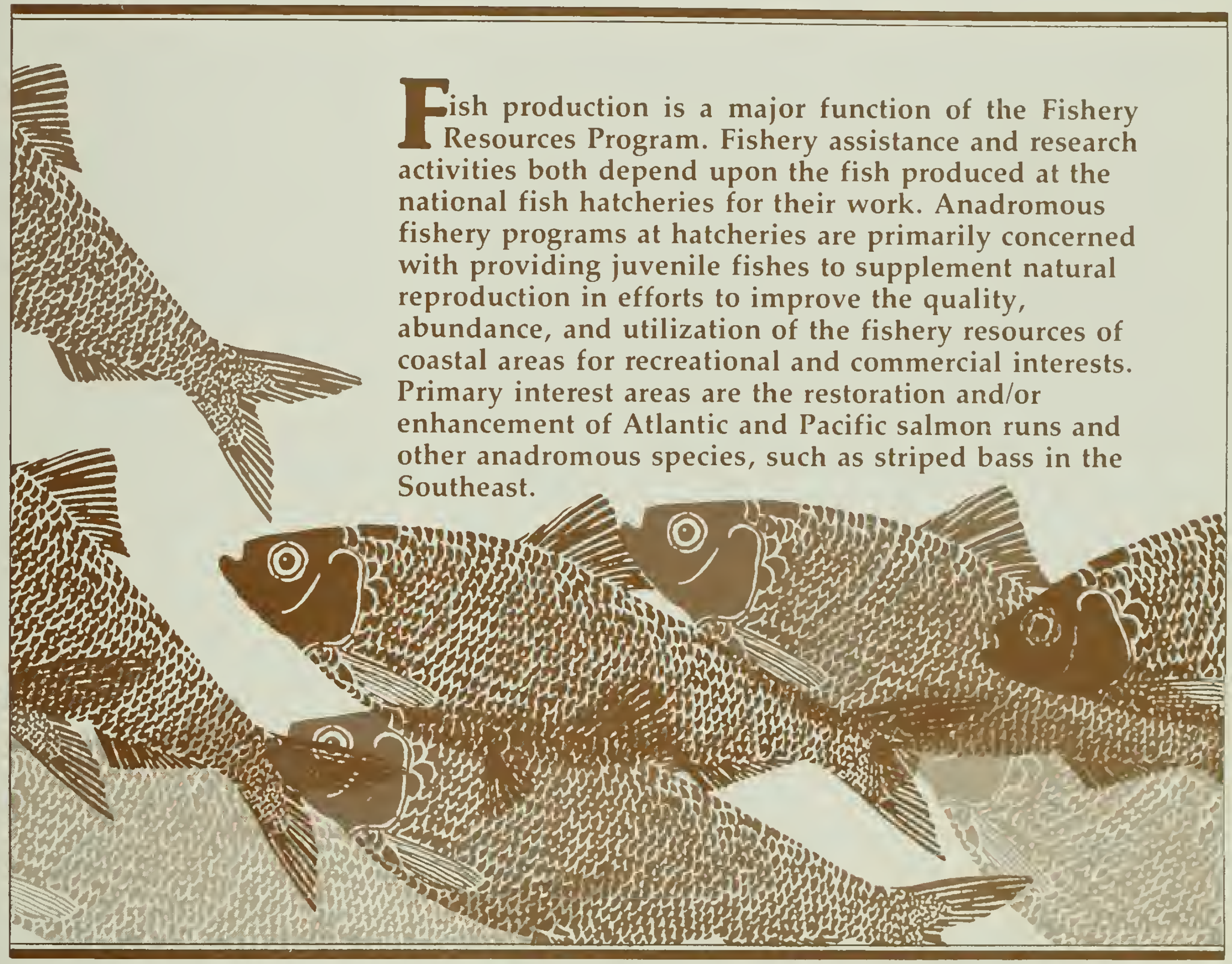
In 1978, West Creek was also treated with antimycin to remove brook trout. Following a post-treatment survey in 1979, greenbacks from Hidden Valley Creek will be introduced into the creek to form the fourth population of this threatened species within Rocky Mountain National Park.

Endangered Colorado Squawfish Collected for Broodstock

Fishery assistance personnel continued their involvement in the Colorado River Fishes Recovery Team during FY 1978. The main activity was collecting adult Colorado River squawfish for use as broodstock at the Willow Beach National Fish Hatchery in Arizona. A multiagency task force was formed to collect fish over 21 inches long—10 from the Colorado River in the vicinity of Grand Junction, Colorado, and 10 from the Green River near Ouray, Utah. Twenty-two Colorado squawfish were finally caught and transported to Willow Beach to serve as broodstock for a planned recovery effort in the Colorado River.

Allegheny Reservoir Fishery Monitored

Fishery resources staff conducted sampling programs on the 12,000-acre Allegheny Reservoir, Pennsylvania, during FY 1978 to monitor survival, growth, and distribution patterns of the fish population. Two million walleye fry were stocked in the spring to provide a walleye fishery. Due to fluctuations of the reservoir's water level during spring spawning, natural recruitment of the walleye has been curtailed. Twenty thousand rainbow trout fingerlings were planted in four tributaries of the Allegheny Reservoir to supplement the trout fishery. Two areas, Twin Lakes and Four Mile Run, received special stockings of Beulah Strain rainbow trout to evaluate the strain's catchability and carryover qualities. Creel census and surveys revealed that the Beulah Strain did not enhance the fishery.



Fish production is a major function of the Fishery Resources Program. Fishery assistance and research activities both depend upon the fish produced at the national fish hatcheries for their work. Anadromous fishery programs at hatcheries are primarily concerned with providing juvenile fishes to supplement natural reproduction in efforts to improve the quality, abundance, and utilization of the fishery resources of coastal areas for recreational and commercial interests. Primary interest areas are the restoration and/or enhancement of Atlantic and Pacific salmon runs and other anadromous species, such as striped bass in the Southeast.

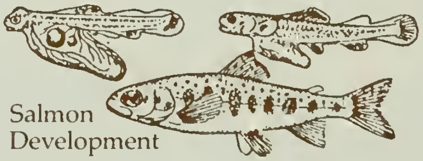
FISH·HATCHERIES
ANADROMOUS · FISHERIES

Hatchery Production Shifts to Salmon

In the Puget Sound and coastal Washington area, initial steps were taken during FY 1978 to shift hatchery production to salmon species that are approaching threatened or endangered status. For example, the Puget Sound spring chinook run has dwindled to fewer than 3,000 spawners in recent years. To improve the chinook fishery, an experimental rearing program was initiated at Quilcene National Fish Hatchery, Washington. Attempts are also being made to identify the major factors limiting production of sockeye salmon in Lake Ozette. The Lake Ozette population, which once exceeded 40,000 fish, has declined to less than 1,000 spawners. The study results will be used to develop a restoration program.

Washington Hatcheries Evaluated

During FY 1978, all Washington-area hatchery operations were evaluated in terms of smolt production and adult returns. A comprehensive report was prepared summarizing the contribution of these hatcheries to the sport and commercial fisheries. Area hatchery contributions to the commercial fishery were found to be 734,000 salmon valued at over $10 million. The contribution to the sport fishery was found to be 151,000 salmon and steelhead, valued at over $3 million.


Salmon Development

Warm Springs National Fish Hatchery Dedicated

The Warm Springs National Fish Hatchery, located on the Warm Springs Indian Reservation, Oregon, was dedicated in traditional Indian ceremonies during FY 1978. Hatchery production of salmon and steelhead will supplement natural reproduction in the Columbia and Deschutes River systems. Rainbow trout production will be used to stock recreational fishing areas on the Warm Springs and Umatilla Indian Reservations.

Limited operation of the hatchery began early this year, with full production expected by 1980. Initially, the hatchery will produce 400,000 spring chinook and 140,000 steelhead smolts annually. Approximately 154,000 rainbow trout will be raised each year for reservation stocking programs.

Chinook Rearing Begins at Hagerman National Fish Hatchery

Production of anadromous fish species was initiated at the Hagerman National Fish Hatchery in Idaho. Fall chinook salmon eggs were successfully reared at the hatchery during FY 1978 on the Service's Abernathy dry diet. As a result, the hatchery is entering into production of the Snake River fall chinook salmon, a stock presently under review for listing as endangered or threatened under the Endangered Species Act. Production of these salmon will assist in the establishment of an egg bank. The fall chinook salmon produced at the Hagerman hatchery this year were stocked into Bureau of Land Management waters in Idaho.

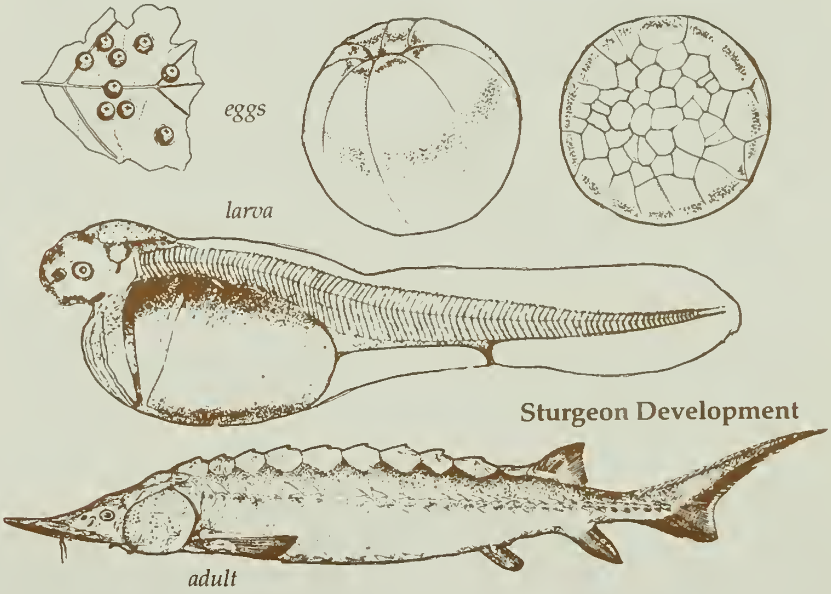
The Hagerman hatchery is also being considered by the Army Corps of Engineers as a steelhead trout mitigation hatchery under the Lower Snake River Compensation Plan. The hatchery entered into a steelhead pilot project in cooperation with the Corps and the Idaho Fish and Game Department to evaluate the feasibility of steelhead rearing and also to provide data for rearing facility design criteria. Steelhead were successfully reared in the hatchery during FY 1978. A final decision will be reached by the three agencies involved in FY 1979 regarding Hagerman's future role in the Lower Snake River Compensation Plan.

Successful Steelhead Spawning Continues in Idaho

The Dworshak National Fish Hatchery's primary focus during FY 1978 was on spawning adult steelhead trout returning to the hatchery. A record number of 12,727 adult steelheads returned, from which more than 18 million eggs were taken. Unspawned fish were transported to waters in the upper Clearwater drainage, and excess eggs and fry were distributed to the Washington and Idaho Departments of Fish and Game. Although the large number of returning fish resulted in a successful spawning season, it was not without problems. Illegal fishing at the entrance to the fish ladder was finally thwarted by hanging a series of cables across the water. Federal, State, and local law enforcement personnel provided excellent assistance to the hatchery.

Production of Anadromous Fish Emphasized

During FY 1978, the Fishery Resources Program continued to emphasize increasing anadromous fish stocks in the Sacramento and Klamath River systems. A major management effort was directed toward implementing the Secretary of the Interior's Indian Fishing Regulations on the Klamath River. Efforts toward restoring Lahontan cutthroat trout and cui-ui runs on the Truckee River system were also continued this year.

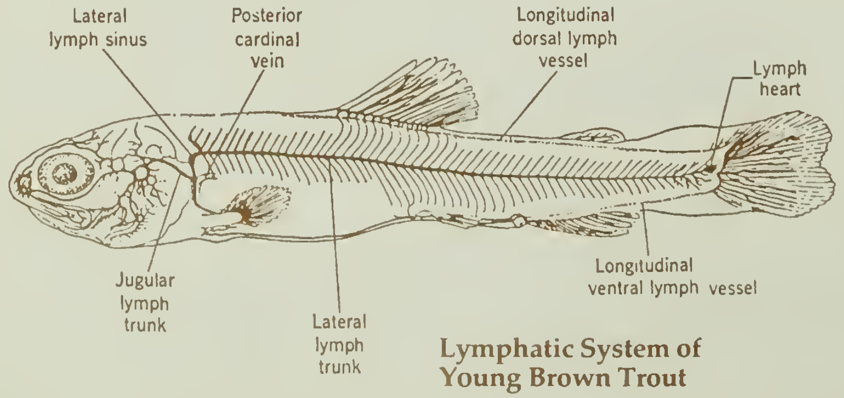


Sturgeon Development

The Coleman National Fish Hatchery was constructed in 1942 as part of the Central Valley Project to help mitigate the loss of anadromous fish spawning areas resulting from construction of the Shasta Dam by the Bureau of Reclamation. From its beginning, the Coleman hatchery has concentrated on production of fall chinook salmon and steelhead trout. However, in more recent years considerable numbers of rainbow trout were produced at Coleman for stocking waters on military bases and Indian reservations in California. This year rainbow trout production was decreased to help meet higher-priority anadromous fisheries goals.

Chinook Salmon Spawned at Fish Facility

The Tehama-Colusa Fish Facility is located on the Sacramento River near Red Bluff, California. The facilities include fish ladders, counting stations, fish trap and selector systems, and a chinook salmon spawning channel complex. These channels were designed to enhance production in the Sacramento River system. A total of 3,957 chinook salmon spawners were stocked in the single-purpose channels and an estimated 9,148,000 eggs were deposited in the spawning channels in FY 1978. An additional 482,000 eggs were placed in the incubation facility. Fall-run adult salmon were blocked at the Red Bluff Diversion Dam because of drought conditions affecting the Sacramento River. Over 20,000 fall-run spawners were trapped and trucked to State and Federal hatcheries and tributaries to the Sacramento River to assure successful production from a portion of this run. Total production from the Tehama-Colusa Fish Facility during 1978, including the dual-purpose channel and incubation facility, was 1,800,000 fish weighing 6,300 pounds.



Lymphatic System of Young Brown Trout

Atlantic Salmon Distributed to Maine Waters

The Green Lake National Fish Hatchery, Maine, currently distributes Atlantic salmon within the State. The great majority of salmon produced at the hatchery is released into the Penobscot River and its tributaries; distribution in FY 1978 was approximately 300,000 smolts and parr. Smolts are released annually in the Union River to establish and maintain a source of hatchery broodstock and provide for a sport fishery. All fish stocked in Maine were progeny of salmon returning to the Penobscot and Union Rivers. Over 60,000 smolts were also stocked into five other Maine rivers in 1978.

Hatchery personnel cooperate with the other agencies in the Atlantic salmon restoration program, including the Maine Atlantic Sea-Run Salmon Commission, the University of Maine, the Maine Department of Fisheries and Wildlife, and the Maine Department of Marine Resources. Hatchery personnel also incubate salmon eggs and assist Canadian fishery workers in taking and shipping eggs destined for Connecticut or Merrimack River programs.

Atlantic Salmon Return to Connecticut River

Because of its strategic location, the Berkshire National Fish Hatchery was chosen as a holding and spawning facility for Connecticut River returnees. During FY 1978, 79 adults were collected at the Holyoke Dam and Rainbow Dam trapping facilities, and were brought to the Berkshire hatchery. Two of these fish survived an outbreak of furunculosis and produced 7,000 good eggs. Plans are now being developed for tagging, handling, and inoculating adult salmon, and for improving holding facilities at the trap sites.

During FY 1978, 130,170 smolts were stocked in the Connecticut River. The agencies involved in the Connecticut River Atlantic salmon restoration program are the Service; the Fish and Game Departments of Vermont, New Hampshire, Massachusetts, and Connecticut; and the National Marine Fisheries Service. The International Atlantic Salmon Foundation has also offered assistance in the program. The power companies that control the trap sites have been most helpful in supporting salmon restoration.

Atlantic Salmon Produced for Merrimack River Restoration

The Nashua National Fish Hatchery, New Hampshire, began production for the Merrimack Atlantic salmon restoration program in FY 1978, a shift which alters the hatchery's distribution zone from other New England programs to the Merrimack River system. Previously the hatchery participated in trout programs and the National Broodstock Program. A total of 478,700 trout were distributed during the year to fulfill commitments, and 105,000 fingerlings were transported to Canada. Two groups of Atlantic salmon were reared this year, one from eggs taken in Tadoussac, Quebec, and the other from landlocked broodstock from Cortland, New York. Problems with gas bubble disease and low water temperatures resulted in a high mortality rate, but the hatchery staff was able to start 60,000 fry feeding. A total of 29,800 Canadian and 9,800 Cortland fish are being held at the hatchery for a 2-year smolt program. Approximately one-third of the Cortland lot might grow enough to become smolts early in FY 1979 at the 1-year plus stage. There is a good possibility that with heated hatchery water a substantial number of fish from future lots will become smolts in one year.

Shortnose sturgeon

Atlantic salmon

Connecticut River Restoration Program Continues

The primary purpose of the Pittsford National Fish Hatchery, Vermont, is the production of Atlantic salmon for the Connecticut River Restoration Program. All smolts produced at the hatchery are stocked in the Connecticut River system. During FY 1978, 97,481 Atlantic salmon smolts were stocked in the Connecticut River, and 50,000 fry were stocked into the White River system. In addition, 83 surplus Atlantic salmon male brood fish were stocked in a Vermont reservoir. Altogether 18,000 salmon from four different lots were tagged with modified Carlin tags.

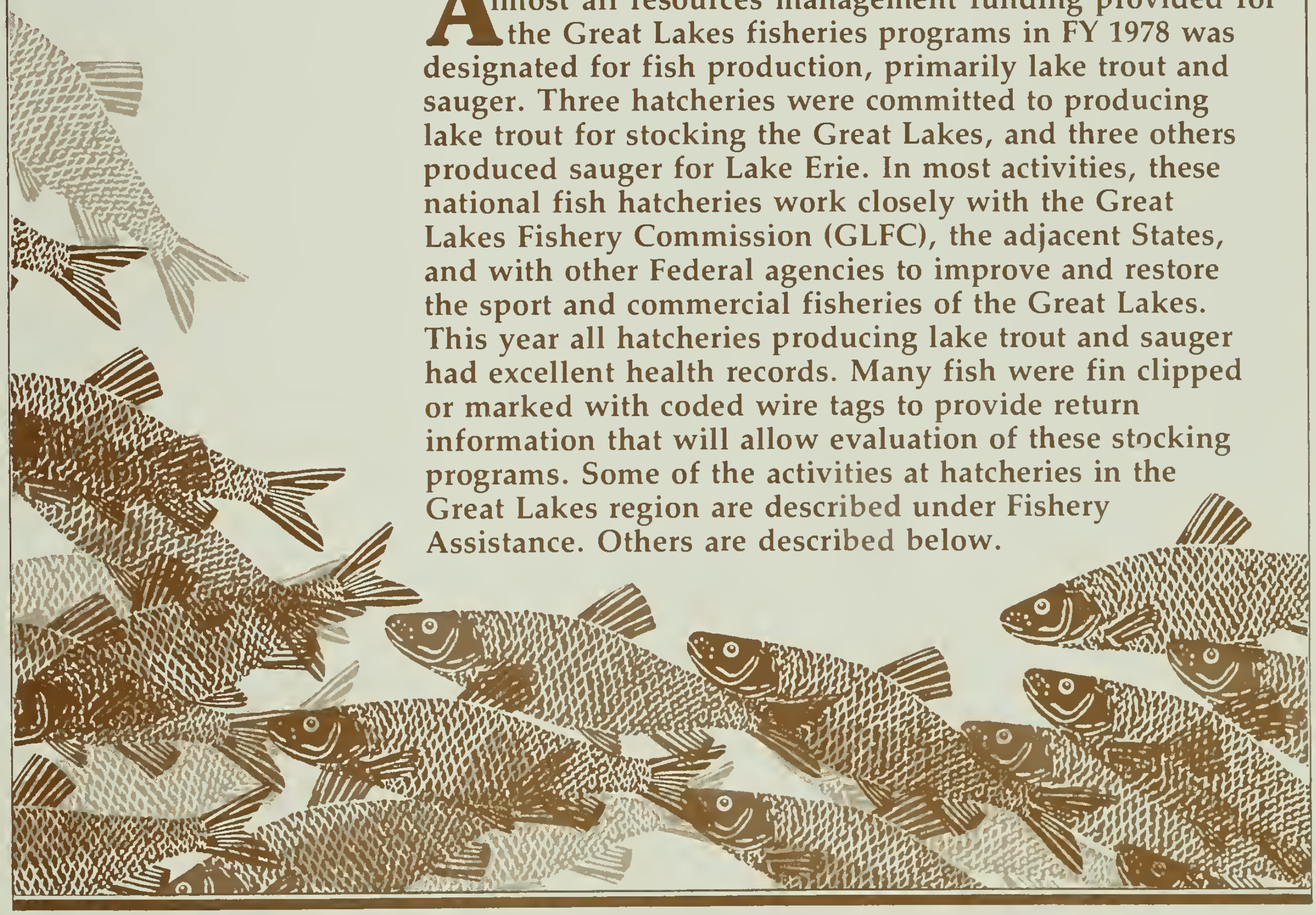
A total of 150,000 green Atlantic salmon eggs were received from the Miramichi River to be incubated for the White River National Fish Hatchery, and 47,500 eyed eggs were received from Tadoussac, Quebec. In addition, 350,000 green eggs were taken from the Atlantic salmon broodstock reared in fresh water.

Striped Bass Produced at Five Warmwater Hatcheries

Five warmwater fish hatcheries were involved in striped bass production in FY 1978. A total of 2.2 million striped bass were distributed this year by fishery resources personnel at the following national fish hatcheries: Cheraw and Orangeburg in South Carolina, Edenton and McKinney Lake in North Carolina, and Frankfort in Kentucky. Stocking into reservoirs has contributed to the establishment and maintenance of a striped bass wild broodstock population. A substantial portion of the striped bass produced in this area is stocked in coastal waters to restore migratory fish populations. In addition, approximately half a million *Morone* hybrids (white bass × striped bass) were distributed in Louisiana waters during 1978.

Atlantic Sturgeon Studies Begin

A 5-year cooperative Federal aid agreement was initiated during FY 1978 between the South Carolina Wildlife and Marine Resources Department and the Service's Orangeburg National Fish Hatchery to develop techniques of spawning, rearing, and transporting Atlantic sturgeon. Efforts will be aimed at collecting valuable life-history data and restoring this species to river systems it formerly occupied. During FY 1978, approximately 21 young sturgeon were captured and transported to the Orangeburg hatchery. They were used to develop techniques necessary to successfully handle, feed, hold, and transport this fish. A special distribution unit was developed in FY 1978 and is now in use. Spawning of Atlantic sturgeon will be attempted in FY 1979.



Almost all resources management funding provided for the Great Lakes fisheries programs in FY 1978 was designated for fish production, primarily lake trout and sauger. Three hatcheries were committed to producing lake trout for stocking the Great Lakes, and three others produced sauger for Lake Erie. In most activities, these national fish hatcheries work closely with the Great Lakes Fishery Commission (GLFC), the adjacent States, and with other Federal agencies to improve and restore the sport and commercial fisheries of the Great Lakes. This year all hatcheries producing lake trout and sauger had excellent health records. Many fish were fin clipped or marked with coded wire tags to provide return information that will allow evaluation of these stocking programs. Some of the activities at hatcheries in the Great Lakes region are described under Fishery Assistance. Others are described below.

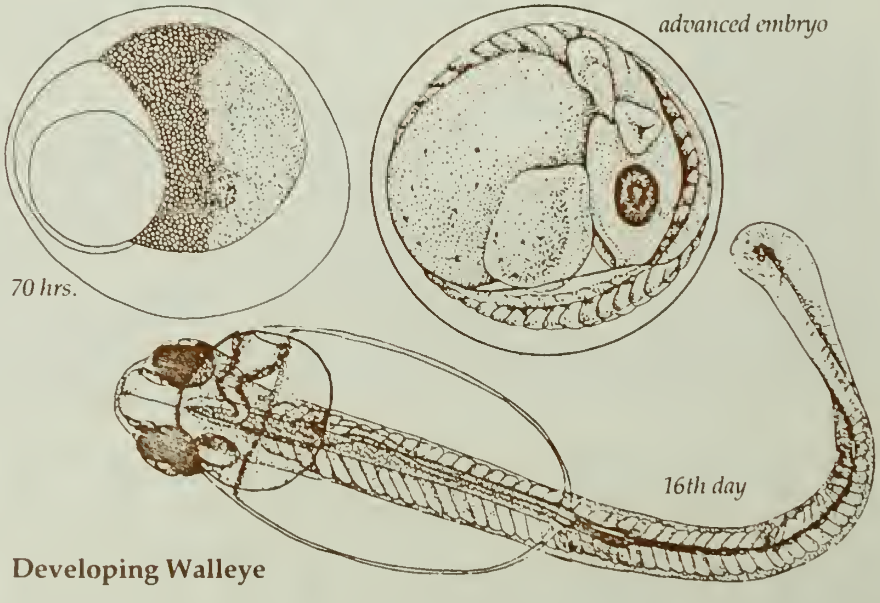
FISH · HATCHERIES

GREAT · LAKES · FISHERIES

Production of Lake Trout for Stocking Continues

During FY 1978, the production of lake trout for Great Lakes stocking programs was the primary program at the Jordan River, Pendills Creek, and Hiawatha Forest National Fish Hatcheries in Michigan. Lake trout were stocked into Lakes Superior, Michigan, and Huron. The stocking of these fish is part of the international cooperative program to restore lake trout populations in the Great Lakes, and allocations to the various States are coordinated by the GLFC. A total of 3,199,000 lake trout were produced by the Jordan River hatchery, while the Pendills Creek and Hiawatha Forest hatcheries together produced 1,602,400 fish. Pendills Creek also stocked 276,100 splake/lake trout backcross fish into Lake Superior and Lake Huron in FY 1978. These were the last such fish remaining, and this program has been terminated by agreement of the cooperating agencies. The Jordan River hatchery also produced 504,000 lake trout on an accelerated growth program; these fish are stocked annually into Lakes Erie and Ontario. Their distribution and stocking was carried out by the State of New York with assistance from Michigan. The health of lake trout reared at the national fish hatcheries was excellent during FY 1978. No serious disease outbreaks were reported and fish survival was high. Broodstock reared at the Jordan River hatchery are not yet mature, but remain free of serious infectious diseases.

The Allegheny National Fish Hatchery, Pennsylvania, produces lake trout for stocking into Lakes Ontario and Erie. During FY 1978, 236,449 lake trout were stocked into Lake Erie and 505,210 were stocked into Lake Ontario. All the lake trout planted were fin clipped. This was the first full year of production at this facility in a program that will annually release approximately a million lake trout and involve a complex mark-and-capture program using both fin clipping and coded wire tags.



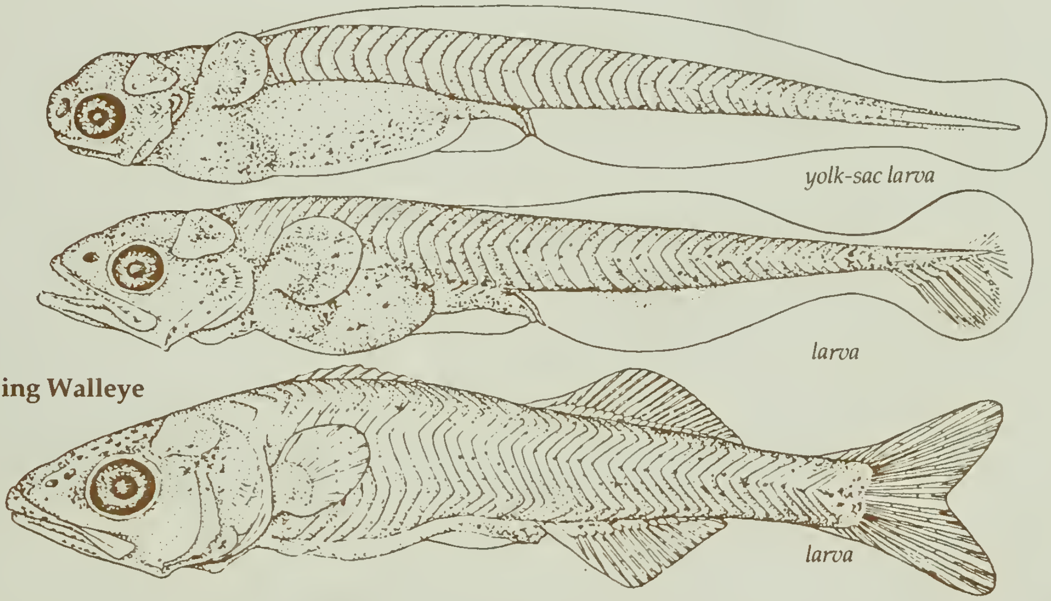
Developing Walleye

Production of Sauger Continues at Hatcheries

The Ohio Department of Natural Resources is attempting to restore the sauger population of eastern Lake Erie and the Fish and Wildlife Service provides assistance in the production of sauger fingerlings. During FY 1978, three national fish hatcheries participated in the production of sauger for stocking in Lake Erie. Genoa National Fish Hatchery, Wisconsin, trapped and spawned sauger in the Mississippi River and provided the eggs to the Hebron and Senecaville hatcheries in Ohio for rearing. Some difficulties have been experienced in obtaining a reliable source of sauger eggs from the Mississippi River, so fishery resources personnel are exploring alternative sources. Because of egg shortages, fewer than 100,000 sauger fingerlings were provided for Lake Erie in 1978.

Species Produced at Genoa National Fish Hatchery

During FY 1978, Genoa National Fish Hatchery, Wisconsin, was involved primarily with the production of largemouth bass, rainbow trout, northern pike, walleye, and sauger. Genoa is the only hatchery in the Great Lakes region with direct access to northern pike, walleye, and sauger spawning runs, and consequently plays an important role in supplying eggs and fry to other hatcheries. Because of their access to the Mississippi River, hatchery personnel also trap and supply various species of fish to laboratories for research purposes.


Developing Walleye

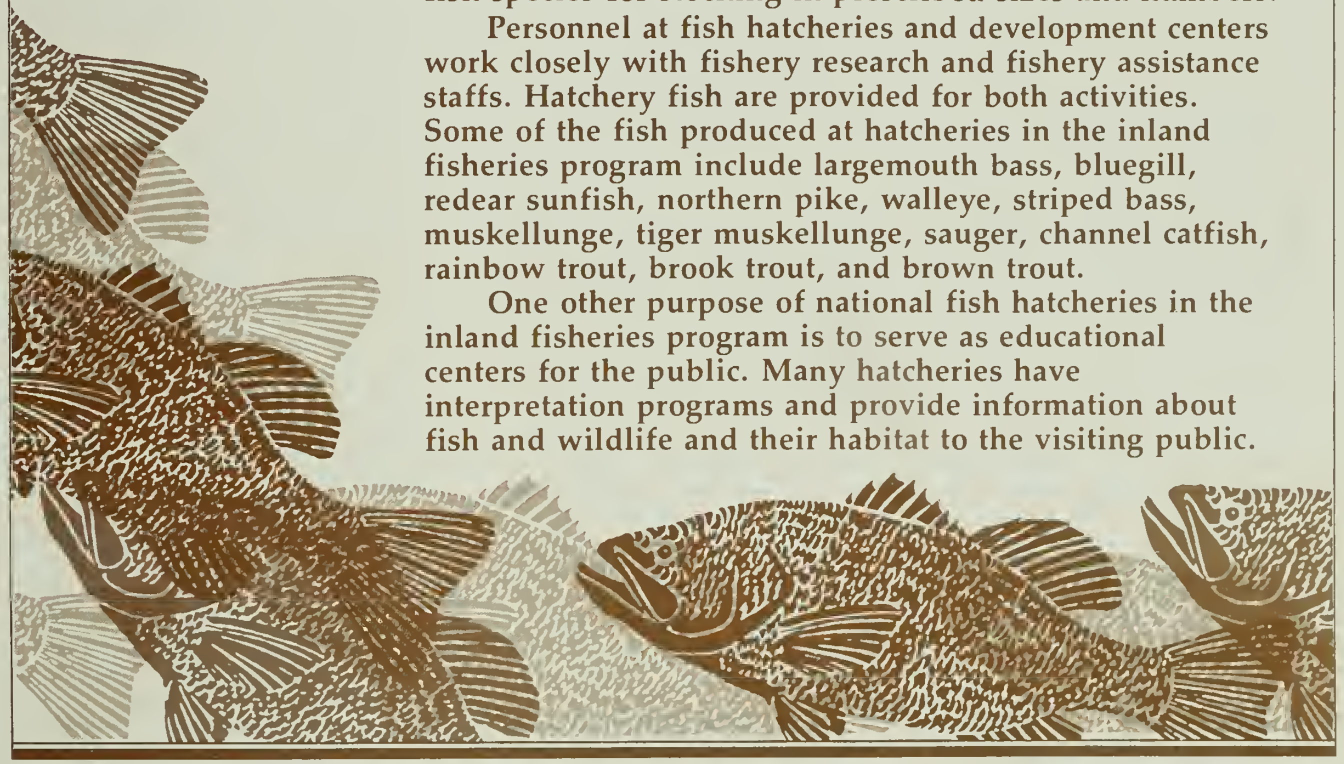
Largemouth bass fry numbers are estimated before transferring them to rearing ponds.

FISH·HATCHERIES
INLAND·FISHERIES

A major objective of the inland fisheries program area is to produce and rear inland fish species for stocking into Federal, State, and Indian waters in order to improve, restore, and maintain recreational fishing. This entails production of various warm-, cool-, and coldwater fish species for stocking in prescribed sizes and numbers.

Personnel at fish hatcheries and development centers work closely with fishery research and fishery assistance staffs. Hatchery fish are provided for both activities. Some of the fish produced at hatcheries in the inland fisheries program include largemouth bass, bluegill, redear sunfish, northern pike, walleye, striped bass, muskellunge, tiger muskellunge, sauger, channel catfish, rainbow trout, brook trout, and brown trout.

One other purpose of national fish hatcheries in the inland fisheries program is to serve as educational centers for the public. Many hatcheries have interpretation programs and provide information about fish and wildlife and their habitat to the visiting public.



Rainbow Trout Evaluated in Montana

Personnel at the Fish Cultural Development Center, Bozeman, Montana, conducted a field evaluation of four selected strains of rainbow trout in cooperation with the Fish Genetics Laboratory of Beulah, Wyoming. The four strains evaluated included the Winthrop, Standard Growth, McConaughy, and Fish Lake strains. The trout were marked with fluorescent pigment by pressure spraying, and with a combination of maxillary and adipose fish clips to evaluate the longevity of the fluorescent mark. The fish were stocked in two ponds at Three Forks, Montana; the smaller pond received 780 fish of each strain and the larger received 1,270 of each strain. A creel census conducted during the summer indicated that the two hatchery strains are more susceptible to fishing than the wild strains.

Warmwater Species Produced in Montana

The Miles City National Fish Hatchery in Montana is a pond culture facility that produces warmwater fish species in addition to rainbow trout. During FY 1978, the hatchery distributed 500,000 walleye fry and fingerlings, 207,444 smallmouth bass, 47,550 largemouth bass, and 153,500 rainbow trout. These fish were stocked in eastern Montana, western North Dakota, Wyoming, and Alberta, Canada.

Optimum Temperature Requirements Evaluated for Brook Trout

Personnel at the Bozeman Fish Cultural Development Center in Montana constructed a system to deliver water at 4, 7, 10, 13, 16, and 19 degrees Centigrade in triplicate replication to test tanks in which brook trout are being raised. The fish were fed at half-hour intervals with automatic feeders at rates greater than they can consume, to provide optimum food availability. Hatchery constants and feeding rates were established for each water temperature. Condition factors were measured and blood chemistry conducted for leucocrit, hematocrit, and total dissolved solids. Preliminary results indicate that the optimum temperature for brook trout is 13 to 16 degrees Centigrade.

Golden Trout Production Continues at Saratoga Hatchery

The primary program of the Saratoga National Fish Hatchery in Wyoming is the production of rainbow trout eggs for the National Broodstock Program, but it is also the only national fish hatchery that has golden trout broodstock and lake and river strains of Yellowstone cutthroat trout broodstock. Eyed eggs produced are shipped to other hatcheries, and to State and foreign conservation agencies. In FY 1978, egg and fry production at the hatchery was approximately 2 million above what was expected. As a result, 4,500 excess lake strain Yellowstone cutthroat trout were stocked on the Wind River Indian Reservation, and surplus golden trout broodstock were transferred to the State of Colorado to provide the nucleus for their broodstock program.

Snake River Cutthroat Trout Produced at Hatchery

The Snake River strain of cutthroat trout and the lake trout are the only two species of fish produced at the Jackson National Fish Hatchery in Wyoming. Cutthroat trout is the only native trout species in the area, and the Snake River strain is native to the south fork drainage which includes the hatchery's major distribution zone. Lake trout were introduced into the area when Yellowstone Park was stocked in 1890. In FY 1978, 746,303 cutthroat and lake trout were stocked into the Teton, Targhee, and Bridger National Forests; the Teton Wilderness Area; Grand Teton National Park; Wind River Indian Reservation in Wyoming; the Uintah and Ouray Indian Reservation in Utah; and in Bureau of Reclamation reservoirs in Wyoming, Utah, Idaho, and Colorado.

Fish Feed Quality Studied at Spearfish Fisheries Center

The quality control program which determines the specifications for Service contract trout feeds and monitors feed production continued at the Spearfish Fisheries Center in South Dakota during FY 1978. Two inspections were made at mills producing contract feeds and numerous ingredients and finished feed samples were subjected to proximate analysis throughout the year. The lack of any significant problem attests to the success of the program. Personnel at the center also provided technical assistance in fish nutrition, feeding problems, and cultural aspects to about 15 State agencies, 10 universities, and 4 foreign countries.

Intensive Culture of Muskellunge Studied

During 1978, studies on the intensive culture of muskellunge continued at the Valley City/Baldhill Dam National Fish Hatchery in North Dakota. Most studies were directed at developing and perfecting techniques to rear muskellunge in intensive culture and thus to expand the information compiled for this species. Results from the program were limited by the loss of eggs during shipment from the State of Michigan. As a result only tiger muskellunge, spawned at the hatchery, contributed significantly to the program this year, but work continues on acceptable conversion rates, density indices, disease control, and optimum temperature range for muskellunge culture. The hatchery's broodstock program for developing a strain of northern pike, walleye, and muskellunge includes one class of walleye and one class of northern pike which have remained in the intensive culture program from the fry stage. These fish should provide future generations of fish more readily adaptable to intensive rearing conditions. Northern pike, walleye, and muskellunge produced at the Valley City/Baldhill Dam hatchery are stocked into Federal and State waters, Indian reservations, and national wildlife refuges in the States of North and South Dakota.

Two-Year Trial on Spawning Walleye Completed

Fishery Resources personnel at the Garrison Dam National Fish Hatchery in North Dakota completed a second year of a 3-year study on various methods to improve spawning techniques with walleye *(Stizostedion vitreum)* in FY 1978. Four methods were tested each year with two groups of fish, one spawned naturally and the other spawned via hormone injection. Methods to reduce adhesiveness of the eggs were also tested and although complete results will not be available until next year, tannic acid seems to work better for this purpose than does clay. These studies are field trials comparing one method to another under normal spawning conditions, and therefore have great technical value for actual walleye spawning operations.

Walleye Eggs Incubated in Cooperative Agreement

The New London National Fish Hatchery, Minnesota, was principally involved with the production of walleye, smallmouth bass, and several other warmwater species in FY 1978. Under a cooperative agreement with the Minnesota Department of Natural Resources, the New London hatchery incubates walleye eggs for the department, and, in return, retains sufficient fry to meet their production commitments. In addition, 50,000 chinook salmon were produced for stocking in Lake Superior waters of the Grand Portage Indian Reservation.

Fish Produced for Research at Lake Mills NFH

A main objective of the Lake Mills National Fish Hatchery, Wisconsin, is the production of fish for research facilities, primarily the LaCrosse National Fishery Research Laboratory. Brook, brown, and rainbow trout were produced and distributed to Federal areas and Lake Michigan through cooperative agreements with Wisconsin, Indiana, and Illinois. Nearly two-thirds of the available pond space was required for walleye production, but yellow perch and muskellunge were also produced. Walleye were distributed to Indian reservations, while yellow perch went to the LaCrosse laboratory. Warmwater species—black bullhead, bluegill, carp, and largemouth bass—were produced in the remaining pond space. Largemouth bass fry from the Genoa National Fish Hatchery were reared to a larger size for cooperative programs.

Cage Culture Produces More Smallmouth Bass

During FY 1978 at the Neosho National Fish Hatchery in Missouri, smallmouth bass were cultured in cages to compare productivity with other culture methods. The cage-culture method of rearing smallmouth bass appears to provide more fish per acre than any other method. These fish were distributed to the States of Colorado and Kansas.

Smallmouth Bass Larva

Crawford National Fish Hatchery Again Classified Disease-Free

During FY 1978, the Crawford National Fish Hatchery in Nebraska was returned to the list of disease-free classified trout broodfish hatcheries. The hatchery produces trout broodfish and eggs as well as catchable and fingerling trout for waters in Nebraska, South Dakota, North Dakota, and Wyoming. All fish production and distribution was accomplished as planned and 250,000 brown, brook, and rainbow trout were stocked during the year. Hatchery personnel expect to produce 4 million brown and 1 million brook trout eggs for the National Egg Pool during FY 1979.

Stocking Continues in Army Corps of Engineers Reservoirs

During FY 1978, the Senecaville National Fish Hatchery, Ohio, produced smallmouth bass, striped bass, walleye, sauger, channel catfish, and flathead catfish. Much of this production is used in management programs on U.S. Army Corps of Engineers reservoirs in Ohio. Some difficulties were encountered this year with striped bass production due to competition from shad that were introduced into ponds through the water supply. However, 96,000 fingerlings were produced for these stocking programs in 1978. The Senecaville hatchery also conducted experimental feeding trials on coolwater fish in support of an interagency effort to develop intensive rearing techniques for these fish.

Walleye Cultured Intensively in Pennsylvania

Significant progress was made in FY 1978 in the culture of coolwater fishes by personnel at the Lamar Fish Cultural Development Center in Pennsylvania. Culture experiments with live food (brine shrimp and *Daphnia*) as a starter showed that walleye could be reared indoors under intensive conditions. Using modified salmonid techniques and equipment, 23 percent of the sac-fry survived through a 3-week period when conversion to dry foods was made. Although this survival was not high, the information obtained will be used to redesign subsequent experiments to increase survival rates.

Rainbow Trout Evaluations Continue in Pennsylvania

Over the past two years, the Lamar National Fish Hatchery and Fish Cultural Development Center complex in Pennsylvania received rainbow trout eggs from the Fish Genetics Laboratory at Beulah, Wyoming, for strain evaluation studies. When these eggs hatch and the fish attain legal size, they are marked by removing one or more fins. A like number of control fish are marked by a different fin clip, and together these fish are stocked in waters where a comparison of their catchability is being conducted. The complex raises rainbow, brook, and brown trout for distribution in the States of Pennsylvania and New Jersey. In FY 1978, the Tylersville Unit distributed 531,234 trout to Federal and State owned and managed waters.

Disease-Free Trout Eggs Produced for Distribution

The main program of the White Sulphur Springs National Fish Hatchery in West Virginia is the production of disease-free rainbow and brook trout eggs for distribution to various Federal, State, and Canadian hatcheries. During FY 1978, the hatchery produced and shipped a total of 10,612,000 eyed rainbow and 984,000 brook trout eggs. Return information shows that good results are generally obtained from these eggs. The hatchery also distributed 60,000 rainbow trout fingerlings to the State of Ohio and 160,000 to the Lamar National Fish Hatchery/Fish Cultural Development Center. Under a cooperative agreement, the State of West Virginia also received approximately 32,662 pounds of catchable trout during the year.

Rainbow Trout Production Continues at Bowden National Fish Hatchery

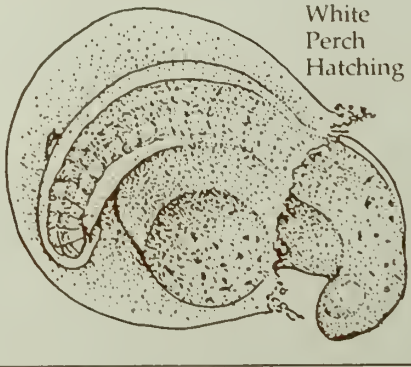
The Bowden National Fish Hatchery, West Virginia, produces fish for stocking into Monongahela National Forest and West Virginia State streams in eight counties. Fish are also distributed to Bradford Lake, Maryland, and to the Wright-Patterson Air Force Base, the Ravenna Arsenal, and the Dayton Veterans' Administration Hospital in Ohio. In FY 1978, Bowden spawned 1.1 million rainbow trout eggs and over 460,000 trout were distributed.

White Perch Embryo

Warmwater Fish Culture Information Generated

Investigations conducted during FY 1978 at the San Marcos National Fish Hatchery and Development Center in Texas resulted in diet, stress and management information valuable to fish culturists. Florida and northern largemouth bass were fed two different diets as summer growth rations, the W–7 ration developed by the Spearfish Fisheries Center and Diet Testing Development Unit and a commercially-produced feed known as CZ10. Both strains of bass rejected CZ10 during the 60-day trial, and fish fed on this diet exhibited reduced growth and conversion rates, varied fish sizes, and more cannibalism than fish fed on the W–7 diet.

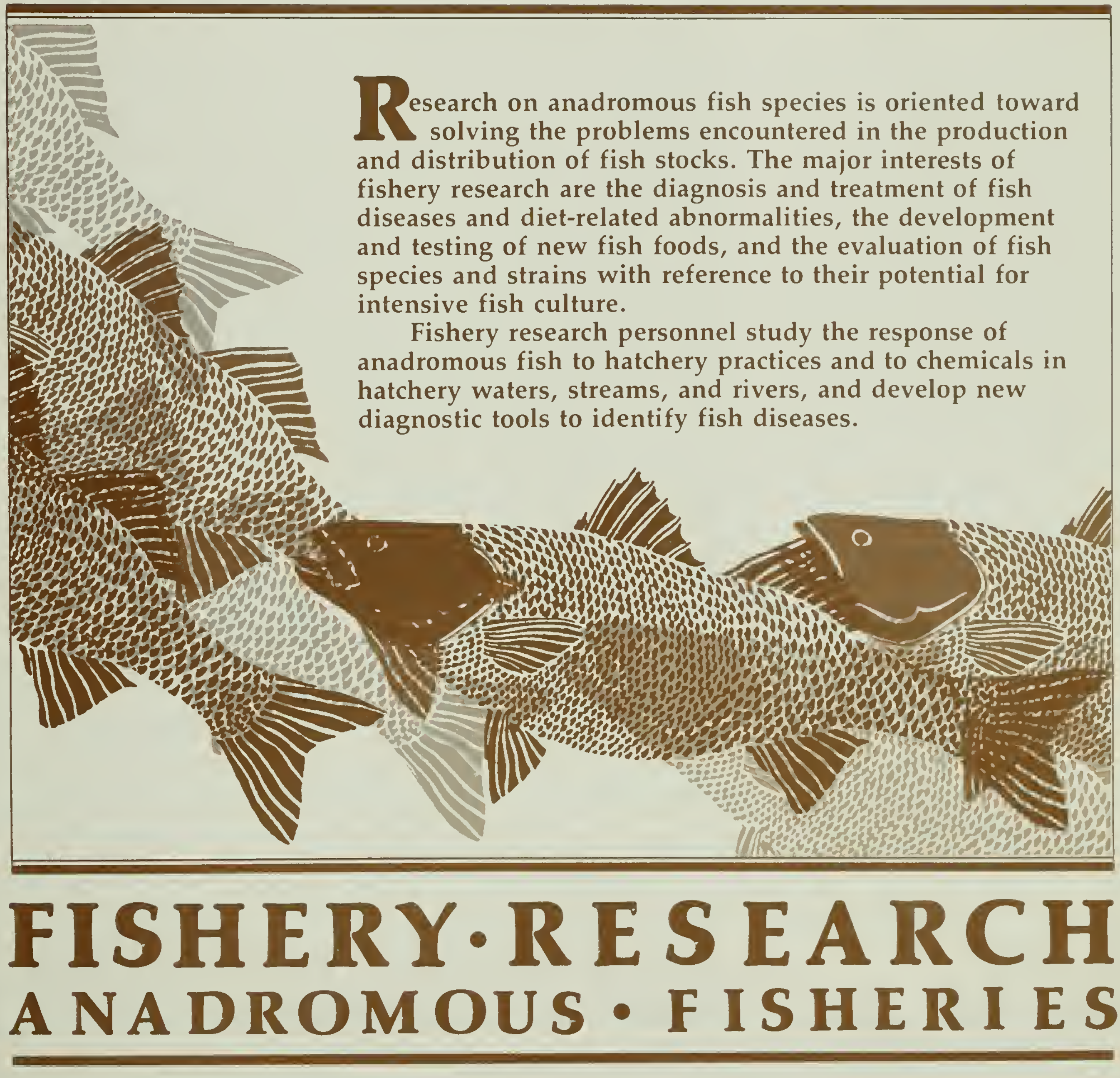
Young of the year smallmouth bass destined for a management study in a Kansas lake were successfully marked by clipping a fin and freezing the tissue with a copper "branding iron" cooled in liquid nitrogen. The use of cold does not cause excessive damage to the surrounding tissue, and appears to cause much less trauma to the fish than does cauterization.



White Perch Hatching

Research on anadromous fish species is oriented toward solving the problems encountered in the production and distribution of fish stocks. The major interests of fishery research are the diagnosis and treatment of fish diseases and diet-related abnormalities, the development and testing of new fish foods, and the evaluation of fish species and strains with reference to their potential for intensive fish culture.

Fishery research personnel study the response of anadromous fish to hatchery practices and to chemicals in hatchery waters, streams, and rivers, and develop new diagnostic tools to identify fish diseases.



FISHERY · RESEARCH

ANADROMOUS · FISHERIES

Smolt Stress During Transport Studied

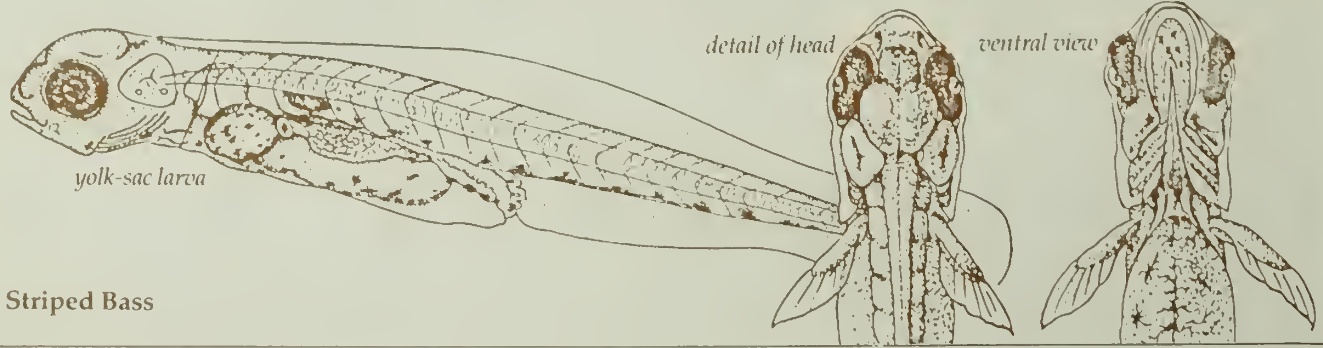
In many projects smolts undergo stress while being transported from one facility to another. In FY 1978, personnel of the Seattle National Fisheries Research Center in Washington identified key elements of the information needed to reduce smolt stress imposed by transport procedures. Efforts were concentrated on hypermagnesemia and hyperkalemia as a function of scale loss, and on the amount of recovery time in freshwater required before the fish can be safely transferred to seawater. Coho salmon were able to maintain homeostasis if scale loss was 10 percent or less and the water in which the fish were transported was maintained at 10 parts per thousand seawater.

Hatchery Practices Influence Smolt Saltwater Tolerance

Fishery research personnel in Washington and Oregon studied the effects of hatchery practices on the saltwater tolerance of Pacific salmon smolts in FY 1978. Smolts of steelhead trout and coho salmon were treated with various medicines for disease control over six different time periods, then placed in full-strength seawater and observed for mortality. Post-treatment mortality ranged from 10 to 80 percent above control levels when fish were transferred directly into saltwater at a salinity of 28 parts per thousand. Mortality thereafter was usually inversely proportional to the time lapse between medication and exposure to saltwater.

The results of this study show that salmonid smolts are easily damaged by medicines. When stressed with otherwise acceptable levels of medication smolts reverted from a high to low salinity tolerance—which may also extend to saltwater preference. Recovery is possible if the fish are given adequate time before entering the ocean. However, it is not clear what physiological systems are attacked by the medicines.

These results clearly demonstrate the need for alternative methods of disease management among smolts. In some circumstances medication may be highly counterproductive, and the ultimate effect may not be evident in freshwater.



Striped Bass

Kidney Disease Transmitted Through Eggs

Studies on bacterial kidney disease conducted by fishery research personnel at the Seattle National Fisheries Research Center in FY 1978 show that the disease can be transmitted through the eggs of infected fish to the progeny. In rainbow trout and chinook salmon, this transmission occurs even when the adult fish have only a subclinical infection and show no overt signs of disease.

Infected Fish More Susceptible to Vibriosis

Most populations of chum salmon in the Puget Sound, Washington, area were found to be infected with the virus of piscine erythrocytic necrosis (PEN) during FY 1978. The incidence of the disease was also high in some Pacific herring populations. The virus can be experimentally transmitted to almost all salmon and trout species, but has been found in nature only in pink and chum salmon. Fish infected with PEN were 2.5 times more sensitive than healthy fish to vibriosis, a common bacterial disease, and, when subjected to low oxygen levels, died at much higher dissolved oxygen concentrations than those lethal to uninfected fish.

Plankton

Effects of Holding Density on Disease Susceptibility Studied

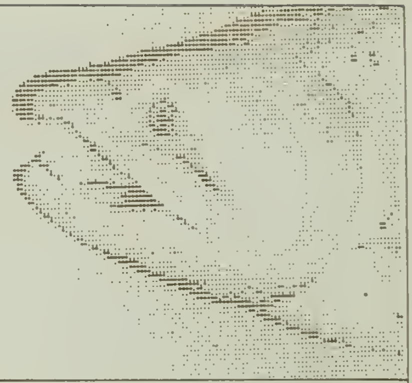
In FY 1978, personnel in Seattle conducted studies to determine the effects of fish-holding densities on the susceptibility to disease of rainbow trout and coho salmon. Results indicated that increasing loading densities from 0.5 to 4 pounds per cubic foot significantly increased susceptibility to vibriosis. In addition, as the temperature decreased, the average time to death increased.

Rearing of Steelheads in Water Reuse Systems Evaluated

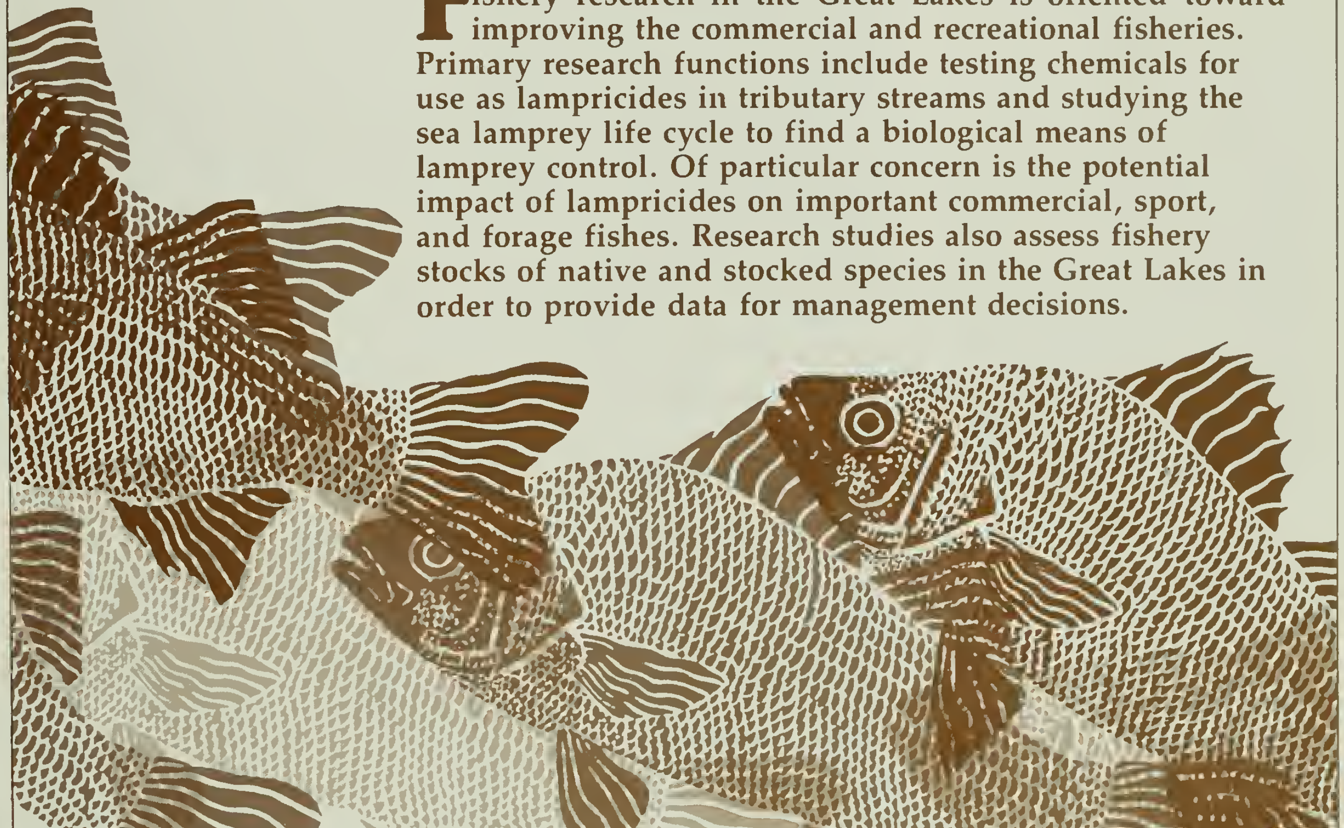
Fishery research personnel evaluated the health and smolt functionality of steelhead trout reared in three water reuse systems in FY 1978. Through clinical tests, the physiological condition of each group was characterized and a method was developed for assessing the degree of chronic stress due to hatchery practices by measuring interrenal cell nuclei and cell size. Significant differences in interrenal hypertrophy were found for the three reuse systems, and these differences were correlated with the severity of stress as determined by clinical tests.

Chemical Residues in Sturgeon Studied

During FY 1978, fishery research personnel continued work on the identification and assessment of residues in sturgeon in the Columbia River. Nineteen fish were sampled and tissues were shipped to a private laboratory for organochlorine and polychorinated biphenyl (PCB) analyses. Although the sample size to date is quite small, a residue pattern is emerging. The average residue levels of PCB and DDT and its metabolites are quite small in that portion of the Columbia River below Bonneville Dam in the vicinity of Astoria, Oregon. Subsequent samples taken upstream from the Bonneville, John Day, and McNary Dams showed an average increase in residue levels, with the greatest increase shown in levels of DDT, which were up to 1.77 ug/g (micro grams per gram) in the McNary Pool. Although these levels are below the Food and Drug Administration tolerance level of five parts per million (ppm), there is some reason for concern with regard to the effect on the reproductive potential of sturgeon.



Fishery research in the Great Lakes is oriented toward improving the commercial and recreational fisheries. Primary research functions include testing chemicals for use as lampricides in tributary streams and studying the sea lamprey life cycle to find a biological means of lamprey control. Of particular concern is the potential impact of lampricides on important commercial, sport, and forage fishes. Research studies also assess fishery stocks of native and stocked species in the Great Lakes in order to provide data for management decisions.



FISHERY · RESEARCH
GREAT · LAKES · FISHERIES

Great Lakes Fishery Laboratory Completes 50th Year

The Great Lakes Fishery Laboratory (GLFL) in Ann Arbor, Michigan, comprises four field stations and five research vessels. In FY 1978, the laboratory completed its 50th year of fishery research on the Great Lakes. The staff addressed a wide variety of Great Lakes problems during the year, including the incomplete restoration of lake trout populations in Lakes Michigan and Superior, the status of heavily preyed-upon forage fishes such as alewives and smelt in Lakes Huron, Michigan, Erie, and Ontario, the continued decline of yellow perch in Lake Erie, the potentially adverse effects on fish habitat in the ecologically important St. Clair-Detroit River system, the possibility that contaminants have lowered the reproductive capacity of deep-water coregonids (principally bloaters) in Lake Michigan, and the extent to which contaminants in sediments resuspended by dredging are absorbed or ingested by Great Lakes fishes.

New Research Vessel Begins Great Lakes Work

The GLFL at Ann Arbor, Michigan, received a new research vessel, the *Grayling*, during FY 1978. It joined four other research vessels operated by the laboratory in support of fishing and environmental research on the Great Lakes. The *Grayling*, operating mainly on Lake Huron, eastern Lake Superior, and northern Lake Michigan, engages primarily in surveys to assess stocks of forage fishes (such as alewives and smelt) and of sport and food fishes (such as lake trout, bloaters, perch, and walleye). Personnel on the *Grayling* also facilitate investigation of the effects on fishery resources of habitat alterations that result from contamination, water withdrawal, maintenance dredging, and shoreline modification.

Right: Research activities in the Great Lakes utilize deep water sampling techniques such as the bottom trawl on the Grayling.

Walleye Populations Recover in Lake Erie

During FY 1978, walleye populations in western Lake Erie reached their greatest abundance in 25 years. There are now six or more year classes contributing to the fishery, indicating a more balanced age structure than formerly existed. Although this strong recovery of the walleye is gratifying to the agencies cooperating in walleye management, there is some concern that the stock may be at or near the western basin's carrying capacity for this species. Growth rates have steadily declined since 1978, and the age of sexual maturity for females has increased.

Lake Trout Populations Show Improvement

During the 1950's, populations of lake trout—an important commercial and sport fish in Lake Superior—were greatly reduced by intense exploitation and by sea-lamprey predation. Partial control of the sea lamprey, protective fishery restrictions, and intense stocking resulted in a great increase in trout abundance in much of the lake by 1971. Present trout populations, however, are affected by variations in numbers of hatchery-reared fish stocked, as well as by an expanding sport fishery, continued sea-lamprey predation, and increased commercial fishing by Indians in Wisconsin waters and in Whitefish Bay, Michigan. GLFL personnel conducted surveys and censuses in FY 1978 to derive various indices of population status and trends. Most lake trout stocks in Michigan waters of Lake Superior continue to show general improvement, with a sharp increase in the abundance of lake trout above the legal length of 17 inches. Prospects for rehabilitating naturally reproducing stocks are also brightened by increases in both the abundance and proportion of native fish in most Michigan waters, except for Whitefish Bay.

Alewife Populations Down in Lake Michigan

During FY 1978, fishery personnel continued monitoring alewife populations in Lake Michigan. Because the buildup of lake trout and Pacific salmon populations through annual stockings of hatchery-reared fish may become limited by the availability of forage fish (mainly alewives), researchers are deriving first-order biomass estimates and projections for alewives and lake trout as part of a continuing examination of salmonid predator-prey relations in Lake Michigan. The adult alewife population has declined markedly since 1975 and appears to be at a lower average level than before. It is thought that this average is influenced by increased predation by lake trout, Pacific salmon, and other salmonids, and by the unusually cold winters of the last two seasons. The next step is to combine alewife and trout biomass estimates with data on seasonal feeding activity and food conversion efficiency to determine the effect of lake trout predation on the alewife.

Studies on Forage Fish Populations Continue

Studies have been conducted for six years on the adequacy of the forage fish base to support native and introduced salmonids in Lake Huron. The alewife population is remaining stable and the rainbow smelt population has increased moderately. Other forage fish species such as the ninespine stickleback and slimy sculpin have noticeably declined. These declines could be due to predation by expanding populations of lake trout.

Alewives and Rainbow Smelt Assessed in Lake Ontario

Studies of the Lake Ontario forage base are being conducted concurrently with studies in Lake Huron and Lake Michigan. Alewives were the most common forage fish, but have experienced a 50 percent decline since 1942. However, rainbow smelt have increased 14-fold since 1972.

Acute Toxicity of Arsenic and PCB's Studied

During FY 1978, researchers performed acute toxicity tests on bloater fry as the initial step in evaluating the potential role of arsenic and PCB's in the decline of Lake Michigan bloaters. The safe concentrations estimated for arsenic and PCB's were well above the reported levels in Lake Michigan waters. The water-quality criteria and objectives recommended for arsenic and PCB's by the Environmental Protection Agency and the International Joint Commission appear to be adequate to protect bloater populations in Lake Michigan.

Synergistic Effects May Cause Fish Kills

In FY 1978, chemical treatment of the Muskegon River, Michigan, with TFM for larval sea-lamprey control resulted in a fish kill, primarily of northern pike and white suckers. A spot check of selected water quality characteristics of the river indicated relatively high nitrite nitrogen levels. It was postulated that an interaction between the nitrite and TFM may have resulted in increased toxicity. Personnel at the LaCrosse National Fishery Research Laboratory in Wisconsin evaluated the possibility of this interaction under laboratory conditions. Northern pike and white suckers were exposed to TFM, nitrite, and a combination of the two and the data were analyzed for toxicosis. For both species the toxicity of the combination was greater than that of the individual compounds, indicating that synergism may have been a factor in the fish kill.

Registration and Classification of Fishery Compounds Attempted

During FY 1978, personnel at the LaCrosse National Fishery Research Laboratory in Wisconsin attempted to clarify the status of several fishery compounds and to determine what studies are needed to establish labels for fishery use. The Environmental Protection Agency responded to an official request for information by stating that rhodamine B and fluorescein sodium dyes do not require registration when used to determine water flows, distribution patterns, and dilution rates for applying fish toxicants. In addition, potassium permanganate was cleared for use as an oxidizing agent to alleviate oxygen depletion and to terminate the piscicidal activity of rotenone and antimycin.

A ruling was also requested from the Food and Drug Administration regarding the registration status of sodium bicarbonate, carbon dioxide, and acetic acid. These chemicals are generally recognized as safe when used in accordance with good manufacturing or feeding practice as food additives.

Feeding of Larval Fish Affected by Water Use Practices

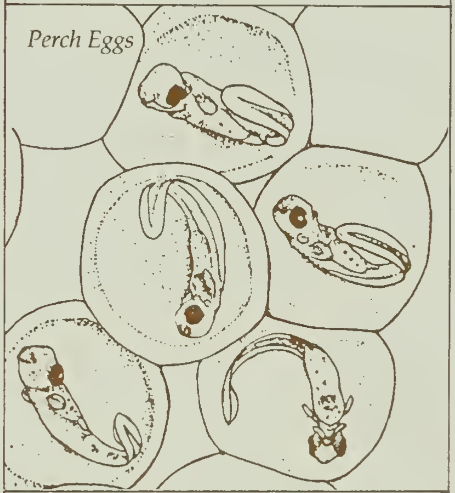
A measurable effect of exposure of fish larvae to industrial and municipal waste discharges may be a change in the feeding activity of the larvae. In FY 1978, fishery personnel examined the alimentary canals of 113 yellow perch larvae from samples collected in the St. Clair-Detroit River system, which links Lakes Huron and Erie. One group of samples was collected in relatively unpolluted water near Belle Isle and another downstream near Grosse Ile, in an area impacted by major industrial and municipal waste discharges. Microscopic examination showed that all larvae were in yolk-sac or early post-yolk-sac stages. About 83 percent of the perch from the Belle Isle area had food in their alimentary canals, compared with 30 percent of the perch from the Grosse Ile area. The Belle Isle perch had ingested an average of five organisms each and the

Retrieving a ½-meter ichthyoplankton net containing fish larvae collected from the Detroit River.

Grosse Ile perch, two organisms each. Because larvae in both transects were in the same life stage and probably from a common population in Lake St. Clair, the data suggest that impaired water quality in the lower Detroit River had a detrimental effect on the food supply and feeding activity of the larvae.

Velocity Barriers Not Feasible for Lamprey Control

In FY 1978, fishery personnel began tests to determine the effectiveness of barrier dams on certain streams to prevent the upstream movement of spawning-run lampreys. The research was designed to yield data on the maximum swimming speeds attainable by spawning-run sea lampreys. Water velocities in the flow-through test flume (1 × 1 × 8 feet) on the Ocqueoc River ranged from 5 to 13 feet per second (ft/s), and water temperature ranged from 16 to 25 degrees Centigrade. Migrating sea lampreys captured were able to swim distances from 1 to 8 feet against the maximum current (13 ft/s) that could be generated in the test apparatus. It was concluded that this ability probably precludes the development of velocity barriers against lampreys in most fish-passage facilities.



Effects of Lampricides on Food Fishes Studied

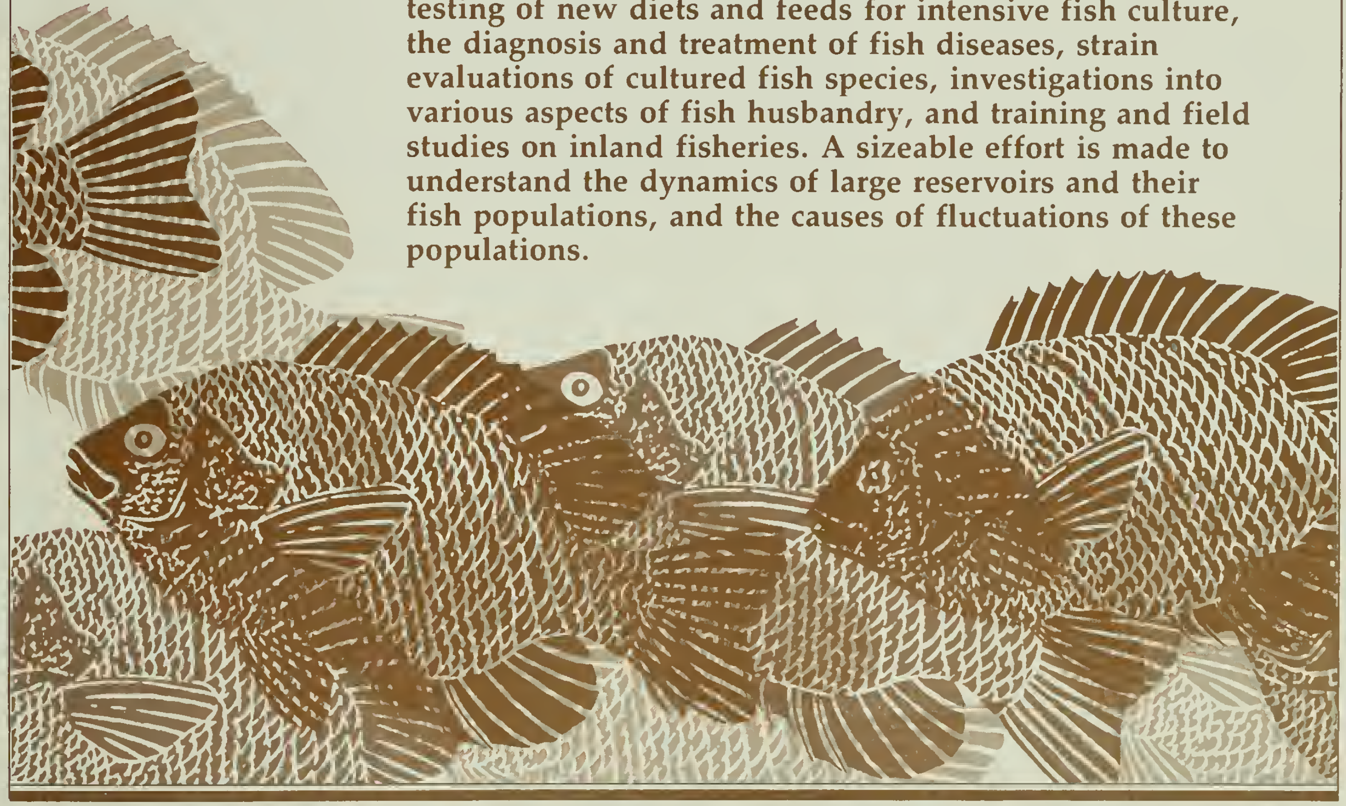
Personnel at the LaCrosse National Fishery Research Laboratory in Wisconsin conducted tests on the uptake of the lampricide TFM by largemouth bass during FY 1978. Largemouth bass were exposed to a solution of TFM for 24 hours and were analyzed for residues during the uptake period and for 72 hours of withdrawal in lampricide-free water. Uptake of the lampricide in largemouth bass was rapid; however, after 48 hours in lampricide-free water, the concentration of TFM in muscle declined to less than the detectable limit. After 72 hours of withdrawal, the head and viscera still contained detectable amounts of lampricide. Largemouth bass apparently detoxify TFM, and since the lampricide is readily metabolized and eliminated by fish, there is little chance that tissue residues could ever become harmful to humans.

Lampricide Registration Approval Received

In FY 1978, the Environmental Protection Agency approved new labels developed by research staff to cover the use of the lampricides TFM and TFM:Bayer 73 as used by the GLFC's sea-lamprey control program. This approval means that all current uses of TFM as a lampricide are now covered by adequate labels. Thus, no further concerns related to the registration of lampricidal uses of TFM are anticipated until the EPA calls for reregistration of the compound.

Fishery chemicals and their degradation products are traced using techniques such as thin layer chromotography to determine their effects in the aquatic environment.

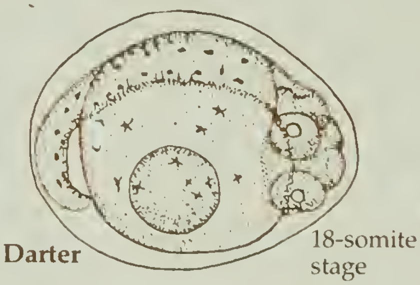
Research on inland fish species is oriented toward solving the problems in the production, distribution, survival, and harvest of fish stocks. The major research efforts of the inland fisheries program are the formulation and testing of new diets and feeds for intensive fish culture, the diagnosis and treatment of fish diseases, strain evaluations of cultured fish species, investigations into various aspects of fish husbandry, and training and field studies on inland fisheries. A sizeable effort is made to understand the dynamics of large reservoirs and their fish populations, and the causes of fluctuations of these populations.



FISHERY · RESEARCH
INLAND · FISHERIES

National Fisheries Center Established

A primary responsibility of inland fisheries research is to perfect techniques for the diagnosis and treatment of fish diseases. Research focuses on the identification of diseases, the testing of disease treatments, and the transfer of information on disease and treatment to fish hatcheries and fishery personnel. In FY 1978, recognizing the need for better management and organization of the various functions of fishery research—especially fish husbandry and propagation activities—the Fish and Wildlife Service established the National Fisheries Center in Leetown, West Virginia. This center encompasses the new Fisheries Academy, the Fish Health Research Laboratory, and the Experimental/Developmental Hatchery, and will include an Environmental Interpretive and Education Unit. The center also includes research facilities located around the nation: the Fish Farming Experimental Station in Stuttgart, Arkansas; the Fish Genetics Laboratory in Beulah, Wyoming; the Fishery Research and Development Laboratory in Wellsboro, Pennsylvania; the Southeastern Fish Cultural Laboratory in Marion, Alabama; and the Tunison Laboratory of Fish Nutrition in Cortland, New York.



The goal of the National Fisheries Center is to efficiently and effectively administer and interrelate the Service's various fish husbandry research projects, certain development functions, and fishery training activities into a comprehensive and flexible program. The center's objectives are to provide timely research and development information on the most efficacious and economical means of providing quality fish for management needs and training for overall management of fishery resources. Each of the components of the center functions both independently and as part of the center. Projects undertaken by each facility are described under that facility. Training activities of the Fisheries Academy are described under Related Program Areas.

Fishing Program for Handicapped Conducted at Experimental Laboratory

A program designed to provide fishing for the physically handicapped began in FY 1978 at the Experimental Fish Hatchery of the National Fisheries Center in Leetown, West Virginia. Ponds and access ramps were rehabilitated and built through the efforts of the center's staff and members of YACC and YCC.

The Experimental Fish Hatchery is part of the efforts at the National Fisheries Center to develop aquaculture methodology, water quality control, demonstration of equipment, fish husbandry methods, and disease-free techniques of operation. The hatchery will also be used to gain insight and baseline data for the design of environmentally controlled propagation facilities for endangered aquatic species.

Bass, bluegill, carp, catfish, and trout were stocked into six ponds at the National Fisheries Center for use by handicapped fishermen.

Nutrition and Diet of Salmonids Studied

During FY 1978, personnel at the Tunison Laboratory of Fish Nutrition, Cortland, New York, conducted studies on the protein and amino-acid needs of rainbow trout. Trout were fed diets containing corn gluten meal or herring meal as the sole sources of protein. The trout fed a plain corn gluten meal grew only six percent as much as the control trout fed herring meal, but when the diet of the corn-fed trout was supplemented with a mixture of essential amino acids, their growth and feed conversion rates equalled those of the herring-fed controls.

In another study, rainbow trout and lake trout fed a commercial whitefish meal as the major source of protein developed bilateral lens cataracts in their eyes. When zinc was added to the diet, cataracts did not develop and fish growth improved. Cataracts do not develop when trout are fed with herring meal. Results of these and other experiments show that salmonids are highly susceptible to eye lesions caused by deficiencies of at least four different nutrients.

Channel Catfish Injected Against Diseases

In FY 1978, studies were begun at the Southeastern Fish Cultural Laboratory (SEFCL) to develop a bacterin for immunizing channel catfish against the pathogen *Aeromonas hydrophila*. Tests conducted after injections show that bacterin-injected fish formed antibodies and developed protection against the disease.

Fish Diets Tested at the Southeastern Fish Cultural Laboratory

In FY 1978, efforts were continued in Alabama to develop low-cost artificial diets for feeding fry and fingerling striped bass and other species. Different sources and ratios of animal-to-plant protein were tested in experimental diets having 38 percent total protein. The fish gained weight on these diets, with growth correlated positively with increasing casein percentage. Heat-treated whole soybean meal was not an adequate replacement for even 25 percent of the casein.

Researchers also continued efforts to define better cultural conditions and diet for larval striped bass. Survival of striped bass fry in culture systems of 5 parts per thousand saltwater reached 27 times that of fry in freshwater. Problems with intensive culture of striped bass fry are common. Although much work has been done at the SEFCL and elsewhere in developing an acceptable artificial diet and a suitable artificial environment, the best growth still occurs in nursery ponds that have rich zooplankton blooms.

Soybean Meal Tested as Catfish and Minnow Feed

Research personnel conducted studies in FY 1978 to compare feeds containing full-fat soybean (FFSB) with feeds containing fish meal and other typical feed ingredients for catfish and minnows. Plant proteins supplemented with fish meal or other animal proteins have been in general use, but fish meal prices continue to rise, and often the better-quality meals are not available.

During FY 1978, six feeds were formulated that contained different amounts of fish meal and FFSB meal prepared at different temperatures. These feeds were given to channel catfish in quarter-acre ponds. The performance of feed containing 50 percent FFSB and no fish meal was nearly identical with feed containing 10 percent fish meal and typical feed ingredients.

In a related experiment, the performance of golden shiners fed typical minnow meal, which contains 10 percent fish meal, and shiners fed FFSB meal supplemented with a vitamin premix was compared. Fish were held in ponds for 75 days and managed according to current commercial practices. Standing crop harvested at the end of 75 days averaged 502 pounds per acre for the group fed minnow meal and 624 pounds for the group fed FFSB meal. It is clear that feeds prepared with heat-treated FFSB meal could be used in place of the currently used feeds containing 10 percent fish meal for the production of marketable-size channel catfish as well as minnows in ponds.

Smaller Pellet Size Promotes Catfish Growth

Personnel at the Fish Farming Experimental Station at Stuttgart, Arkansas, conducted comparison tests of channel catfish fed small and large pellets in FY 1978. The choice of feed pellet size may be one method of reducing objectionable size variation. In this comparison channel catfish were fed identical quantities of either large (0.10 gram) or small (0.04 gram) pellets. Fish offered the smaller pellets grew more uniformly. Under test conditions, the use of numerous small pellets provided a more nearly equal opportunity for all fish to obtain a portion of the ration, and consequently growth was more uniform.

New Parasites Identified

Research personnel at the National Fish Parasite Referral Service of the Fish Farming Experimental Station, Arkansas, identified and verified several fish parasites in FY 1978. Identification of *Chilodonella hexasticha*, the warmwater chilo, was completed, and verification specimens of two parasites that had never been reported in North America were obtained from paddlefish: the coelenterate parasite of Eurasian sturgeon eggs, *Polypodium hydriforme*, and a microsporidian, *Pleistophora sulci*. Another new parasite of the paddlefish, *Eimeria* sp., which appears to be a serious pathogen in the liver and kidney, is also under study. An important European gill parasite, *Cryptobia branchialis*, has also been identified in goldfish; however, the North American strain appears to differ somewhat from the European strain.

Chemicals Evaluated for Control of "Ich"

One of the most destructive parasitic organisms in warmwater fish culture is *Ichthyopthirius multifilis*, commonly referred to as "Ich." Although malachite green is an effective Ich control chemical, it has not been registered for fishery use. To find another effective means of Ich control, researchers evaluated other chemicals in FY 1978. Tests were done on Ich trophozoites, a free-swimming stage of the parasite that develops into infective tomites in 10 to 12 hours. The therapeutant Furanace at 0.2 parts per million was effective against Ich parasites.

Rainbow Trout Strains Characterized Genetically

Personnel at the Fish Genetics Laboratory in Beulah, Wyoming, have for several years been involved in the characterization of different strains of rainbow trout and their suitability for various environments and management uses. In FY 1978, studies continued on 18 strains, 12 of which are from hatchery broodstock and 6 from wild stock. Results of laboratory tests under controlled conditions show significant differences between strains, especially in survival, growth, feed conversion, and frequency of vertebral deformities. This last characteristic, measured in six strains, ranged from 7 to 34 percent; the highest frequencies were found in strains that had been retained in hatchery environments for the largest number of generations. These results suggest that inbreeding may account for many of the deformities found in some hatchery strains. Differences were also found among strains tested in production hatchery and field environments. Characterization of these and other strains indicates a potential for effectively matching strains to a variety of specific management uses.

Effects of Inbreeding Rainbow Trout Studied

Research personnel continued studies on inbreeding of rainbow trout at the Fish Genetics Laboratory in Wyoming in FY 1978. These studies have demonstrated that different levels of inbreeding may be responsible for significant depression in a number of traits. It is clear that inbreeding produces serious adverse effects on the general vigor and performance of rainbow trout. Alternative mating techniques have been defined for hatchery broodstock to reduce this problem. One technique studied is crossing different strains and inbred lines.

Training in Fish Genetics Begun

The first annual Fish Genetics Short Course was presented at the Fish Genetics Laboratory in Beulah, Wyoming, in FY 1978. This course was taught as part of the new Fisheries Academy of the National Fisheries Center in Leetown, West Virginia. Subjects covered in the course included an introduction to basic genetics, strain characteristics, inbreeding effects, and methods for strain maintenance and improvement. This material was summarized and given to each student in the form of a reference manual. Personnel at the laboratory are also preparing a catalogue of strain characteristics of rainbow trout and a breeding and selection methods manual. These efforts are part of a program to provide more effective and timely information to fishery resource managers.

New Diagnostic Method for Bacterial Diseases Developed

Because rapid and accurate diagnostic procedures are essential for effective control of diseases, personnel at the Fish Health Research Laboratory, West Virginia, have concentrated on the adaptation of serological procedures for disease diagnosis. In FY 1978, staff at the laboratory developed a new technique, the direct fluorescent antibody test (FAT), for diagnosis of bacterial kidney disease, furunculosis, and enteric redmouth disease. This is an adaptation of the indirect fluorescent antibody test (IFAT). The IFAT is carried out in two steps and consists of treating test material from fish with a specific antiserum, followed by the addition of a second serum that is coupled with a fluorescent dye. Bacteria that retain the dye fluoresce brilliantly when viewed with a microscope under ultraviolet light. Although the IFAT is more rapid than methods previously used, 2 hours may be required for its performance. The direct fluorescent antibody test, however, can be completed in 7 minutes and is a one-step test in which the fluorescent dye is coupled directly to specific antisera.

Fish Cell Culture Repository Established

The Fish Health Research Laboratory in Leetown, West Virginia, established a repository of selected fish cell lines in FY 1978 to assist in the replacement of fish cell cultures. Fish cell cultures are maintained by research and diagnostic laboratories to detect the presence of viruses, and must be replaced periodically because of microbial infection or as a good management practice. The cell cultures maintained at the laboratory have been tested for quality and are certifiable as free of detectable contaminants, including mycoplasmas. The cells are stored under liquid nitrogen and should remain viable for at least 10 to 15 years. These five cell lines are now available for distribution: bluegill fry (BF–2), brown bullhead (BB), chinook salmon embryo (CHSE), fathead minnow (FHM), and rainbow trout gonad (RTG–2). Cell lines have also been initiated from American shad, striped bass, and kokanee. Laboratory personnel have also made a world survey of literature and research laboratories to compile information on existing fish cell lines. There are now 50 cell lines available, representing 14 families of fish.

Further tests were conducted during FY 1978 at the laboratory to develop methods for detecting mycoplasmas, which are bacteria-like organisms that can kill cells in cultures. The bisbenzamide staining method, which reveals chromosomal nucleic acid as a fluorescent lime-green color, was found to be sensitive and rapid. This method reduces by 7 days or more the time required to evaluate cell cultures for mycoplasma contamination.

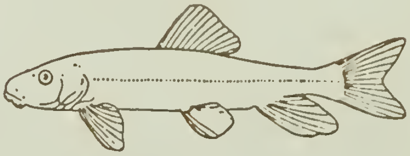
Antisera and Antigens Distributed for Disease Diagnosis

Staff at the Fish Health Research Laboratory in West Virginia produced antisera and antigens for use in the serodiagnosis of fish diseases. During FY 1978, more than 450 vials of lyophilized antisera were distributed upon request, primarily to Federal biologists. When supplies were sufficient, State, private, university, and foreign government requests were also filled. The production of these biologics is regulated by the number of requests. Antisera to *Yersinia ruckeri,* the causative agent of enteric redmouth disease, and *Aeromonas salmonicida,* the agent of furunculosis, are the two in most demand and are, therefore, those most often produced. Whenever possible, the homologous antigen is distributed along with the antiserum.

Impact of Exotic Fishes Studied at New Laboratory

In FY 1978, the Fish and Wildlife Service established a National Fishery Research Laboratory at Gainesville, Florida, to conduct research on exotic and nonnative fish species that have become established or are likely to become established in the Nation's waters. Large numbers of exotic fish species are introduced into the United States each year for commercial, recreational, and research uses, and many have intentionally or accidentally been released into natural waters where they have established breeding populations. Exotic fish often compete successfully with native fish species and disrupt aquatic ecosystems. This laboratory will be responsible for determining the distribution, status, and effects of the exotic fishes that are already established; for supporting regulations to prevent further introduction of undesirable species; and for development of the protocols and studies that must be completed before a new exotic species can be purposely released into the open waters of the nation.

At present 43 species of exotic fishes are known to occur in U.S. waters, of which 25 are found in Florida. Some exotic species, such as the carp and the goldfish, have been widely established for many years. Others, such as those belonging to the genus *Tilapia,* various tropical aquarium fishes, and grass carp are relatively new additions whose potential impacts are not fully known.



Progress Made Toward Registration of Fishery Chemicals

Researchers at the National Fishery Research Laboratory in LaCrosse, Wisconsin, continued study and data collection for the registration of two fishery chemicals in FY 1978. Information on formalin was provided to the Food and Drug Administration for the development of proposed-use label and package inserts, as were relevant reprints that support the efficacy claims for formalin as a disease control chemical. The laboratory staff also prepared briefing materials on formalin for a meeting between FDA and the EPA to discuss the registration for the use of formalin in fisheries. Formalin has now been reviewed and passed on by all divisions within FDA except one.

Betadine is another very effective disinfectant for bacterial and viral pathogens on fish eggs. The Purdue-Frederick Company has already obtained registration for the chemical for human use, so all mammalian safety and residue work has been completed. An arrangement was made with Tavolek, Inc., to submit a "new animal drug application" to cover the use of betadine in fisheries, and all of the laboratory's data relating to betadine was forwarded to Tavolek in Seattle, Washington.

New Piscicide More Toxic to Carp Tested

In FY 1978, research personnel tested a new piscicide that had been shown to be more toxic to carp than to other warmwater fishes. The piscicide, a terpine derivative known as GD–174, had been tested in field applications with inconsistent results. To further evaluate this piscicide, the staff at the National Fishery Research Laboratory in LaCrosse, Wisconsin designed laboratory toxicity tests to weigh the individual effects of photodegradation, turbidity, aquatic vegetation, pH, and temperature. In these tests the activity of the compound was reduced in cold water, in acid water, and in turbid water where bentonite or Crowley silt loam were major components, and in water containing the waterweed *Elodea* sp. The activity was not affected by exposure to ultraviolet light or duckweed (*Lemna* sp.) or in turbid waters where turbidities were produced by kaolin or barium sulfate. The factors affecting activity may preclude the use of this compound as a general or selective fish toxicant; however, the identification of a compound that carp cannot metabolize as well as other warmwater fish is extremely important, because it may lead to the discovery of a related compound or analogue that is better suited for use as a general fish toxicant.

Effects of Silt and Sedimentation on Freshwater Mussels Studied

Major alterations on the Mississippi River have resulted in large amounts of silt and sand sediments along navigation channels. Due to recent concern about environmental degradation and ecological implications of maintenance dredging, the Army Corps of Engineers contracted with the LaCrosse National Fishery Research Laboratory in Wisconsin to determine the acute effects of dredge spoils on three species of mussels: the pig toe, *Fusconaia flava;* the fat mucket, *Lampsilis radiata luteola;* and the pocketbook, *Lampsilis ventricosa.* Results showed that over 50 percent of the fat mucket and pocketbook clams were able to emerge from about 7 inches of sand or silt overlays, but that pig toes were unable to negotiate 4 inches of silt.

These studies showed that the type of soil overlay made little difference in the emergence of fat mucket and pocketbook clams. Emergence is actually a first step in survival; later steps involve the adaptation to new substrates or migration to a suitable substrate.

Predator-Prey Relationships in Reservoirs Studied

During FY 1978, researchers continued to accumulate data on 1,500 large reservoirs in the U.S. as part of the National Reservoir Research Program. These reservoirs now provide about 30 percent of all freshwater fishing in the country. Because predatory fishes, such as black bass, crappies, white bass, striped bass, catfish, walleye, and pikes, make up 70 percent of the average sport fish harvest from reservoirs, management goals have been directed towards improving the variety and harvest of predatory fish by introductions of both predator and prey species. Researchers have developed a technique to evaluate the effectiveness of these stockings. This "available prey-predator (AP/P) ratio" is based on fish samples collected after the application of rotenone to blocked-off coves. This ratio describes the adequacy of the prey crop to sustain the existing predator crop and enables the fishery manager to estimate the additional biomass of predators that could be supported, or conversely, to estimate the loss of predators due to natural mortality as a result of inadequate food supplies.

Analyses of data from many southern reservoirs indicate that predator numbers tend to exceed food resources when reservoir environments are perturbed, but return to normal equilibrium within one year under stable conditions. Prey crops, however, decline more slowly, requiring up to four years to return to a minimum stable level. Examinations of these data indicate that natural mortality is the major factor causing fluctuations in predator populations in reservoirs.

Effects of Power Plant Operations Evaluated

Studies on the fish populations and related trophic levels began in 1972 on Lakes Keowee and Jocasse in South Carolina, prior to the startup of Duke Power Company's Oconee nuclear generating and pump storage facilities on the two lakes.

Three sampling methods were used on both Keowee and Jocasse reservoirs in 1978 to detect changes in the adult fish populations since studies began in 1972. Gill-net samples and cove rotenone samples in Keowee Lake showed a decline in the relative abundance of chain pickerel, carp, quillback, silver redhorse, brown bullhead, bluegill, and yellow perch. However, trends in abundance for the flathead, bullhead, largemouth bass, and black crappie differed depending on the sampling method used.

Pumping Reservoir Water for Irrigation Affects Fish

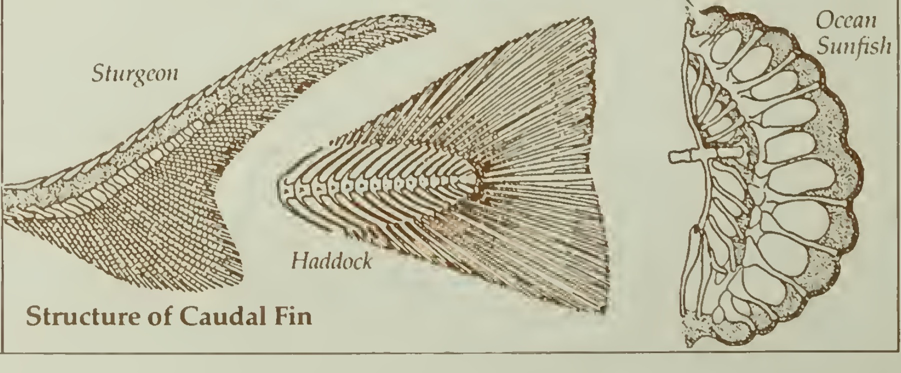
The use of water from Missouri River reservoirs to irrigate adjacent cropland has increased in recent years. Before 1976, the Army Corps of Engineers had issued one permit for taking water from Lake Oahe for irrigation. An aerial survey conducted in FY 1978 revealed 162 irrigation pumps in operation. To reduce entrainment of larval fish, Service personnel requested that irrigation intakes be blocked with quarter-inch mesh screens, be placed in water at least 20 feet deep, and have a water approach velocity of not more than 0.05 feet per second.

To evaluate the effectiveness of these guidelines, researchers conducted a study to determine the number and species of larvae entrained by intakes installed in shallow (5 feet) and deep (20 feet) water and with pumps operating at 2 and 3 cubic feet per second. Larval fish were entrained throughout the period of study from May through mid-August. Placing the intake structure in deep rather than shallow water significantly reduced the number of larvae entrained. Increasing pump volume from 2 to 3 cubic feet per second did not significantly increase the catch. These studies show that the guidelines suggested by Service personnel for removal of irrigation water from the Missouri River reservoirs are necessary to protect young fish.

South Central Reservoir Investigations Continue

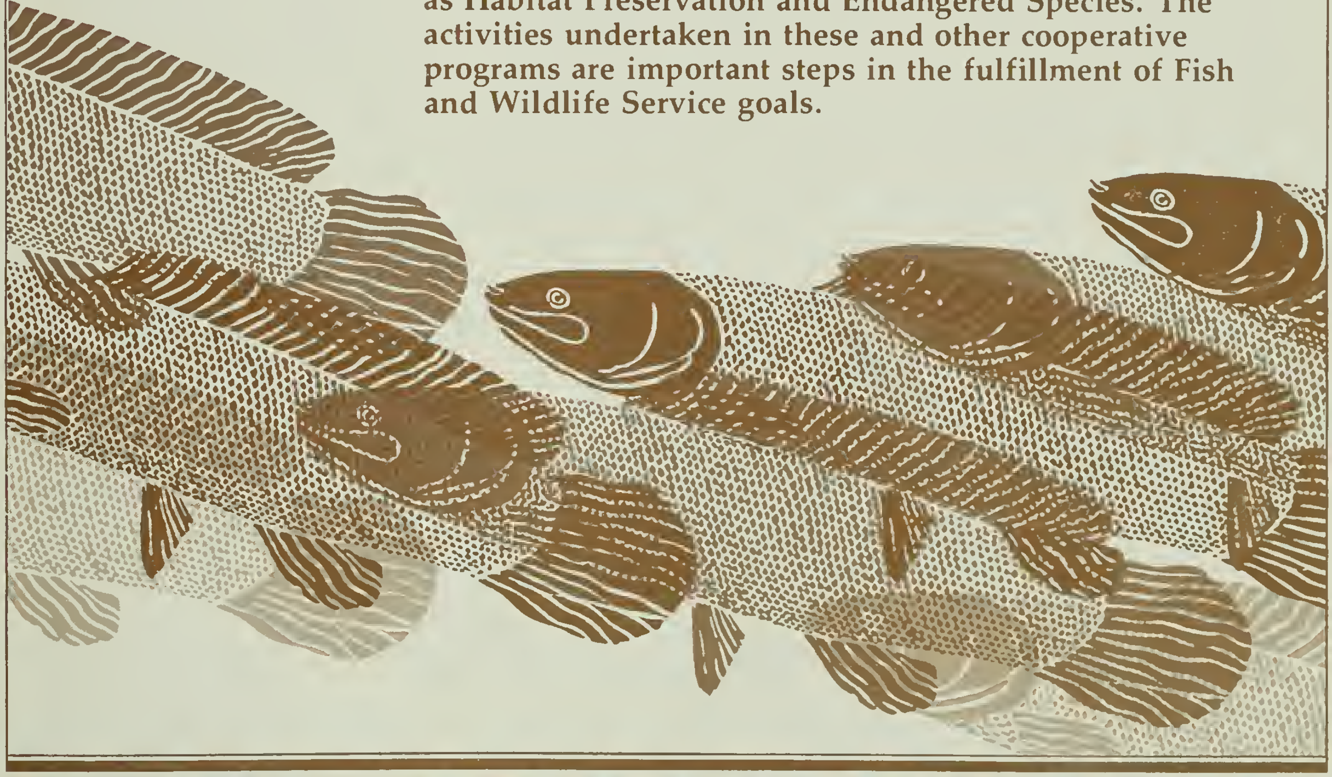
For several years research personnel have conducted long-term studies on the dynamics of reservoir fish communities and the role of the physical environment in determining the structure and production of important sport fishes. In FY 1978, studies continued on Beaver and Bull Shoals Lakes which are impoundments on the White River in Missouri and Arkansas.

A water level management plan was conducted on Beaver Lake by the Army Corps of Engineers and the Arkansas Game and Fish Commission. The water level was drawn down nearly 30 feet due to drought conditions in 1977, and a dense growth of terrestrial vegetation developed. The lake was refilled early in 1978, inundating this vegetation. Preliminary results of a study on the effects of the vegetation on fish production indicate record levels of black bass production and survival. Similar results were obtained in Bull Shoals Lake.



Structure of Caudal Fin

Fishery resources activities are interrelated with other Fish and Wildlife Service programs, with Department of the Interior programs, and with other Federal and State programs involving fish and wildlife and their habitats. Many of the activities conducted as a part of Fishery Resources also contribute to other Service programs, such as Habitat Preservation and Endangered Species. The activities undertaken in these and other cooperative programs are important steps in the fulfillment of Fish and Wildlife Service goals.



RELATED PROGRAM AREAS

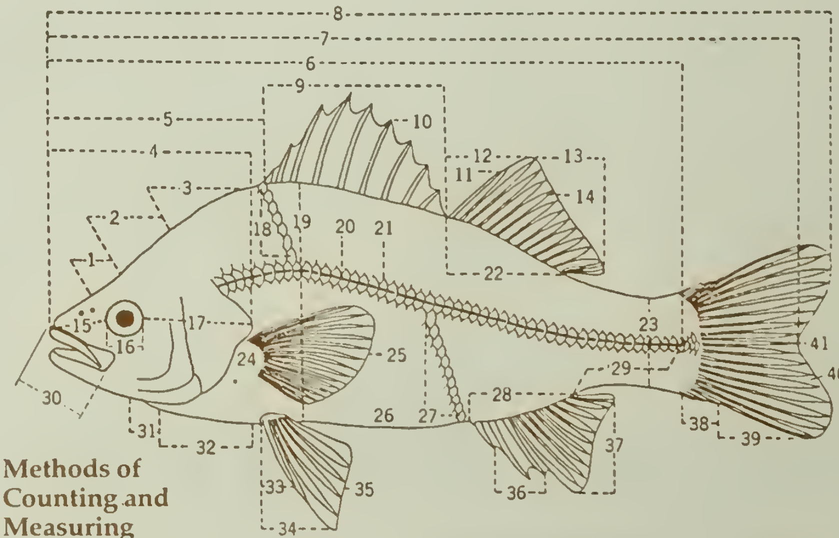
Habitat Preservation

During FY 1978, many projects of the Fishery Resources Program were involved with the preservation of fish and wildlife habitat, including studies to identify and evaluate environmental contaminants that affect these resources. Fishery Resources personnel in all areas of the country participate in the National Pesticide Monitoring Program by collecting fish samples for evaluation from rivers and streams.

New Hampshire fishery resources personnel participated in the joint U.S.-Canada Spruce Budworm Aquatic Monitoring subcommittee. The subcommittee met in Montreal in 1978 to discuss the problems and techniques associated with monitoring the effects of pesticide applications for spruce budworm control on aquatic life.

In Pennsylvania, fishery resources personnel attended meetings with representatives from the oil industry and the U.S. Forest Service to discuss problems and solutions concerning many aspects of the degradation of the environment as a result of the vast oil and gas exploration being conducted on Federal lands in the State. Many oil spills were investigated and technical assistance was provided during cleanup operations to minimize environmental damage.

Of particular interest in FY 1978 was the evaluation of Service activities towards fish habitat protection from the adverse impacts of logging on the Quinault Indian Reservation in Washington. This evaluation shows that when recommendations made by fishery resources staff are not followed, habitat damage from logging is great. Fishery Resources personnel also cooperated in activities for the preservation of Truckee River habitat in Washington. Recommendations concerning impacts and alternative actions were developed regarding the channelization and tunneling projects proposed by the Army Corps of Engineers.



Methods of Counting and Measuring

Interpretation and Recreation

Many Fishery Resource facilities are open to the public and receive large numbers of visitors during the year. At some hatcheries and development centers there are aquaria containing specimens of native fish of the area as well as those fish species used by personnel in hatchery and stocking programs. Fishery resources personnel conduct tours of facilities and distribute pamphlets and brochures describing operations. For example, in 1978 the Spearfish Fisheries Center in South Dakota was declared a National Historical Site, and over 20,000 people visited the combined Spearfish and McNenny National Fish Hatcheries located there. In Washington County, Oregon, fishery resources facilities were used by the Intermediate Educational District in an outdoor education program for sixth-grade students.

The National Aquarium in Washington, D.C., is the oldest aquarium in the United States. It was established in 1873 in Woods Hole, Massachusets, and moved to Washington in 1888. The Aquarium was established to provide a place for the public to become familiar with the world of aquatic life.

Fishery biologists in Tennessee collected the snail darter *Percina tanasi* **in an effort to propagate this endangered species.**

Endangered and Threatened Species

During FY 1978, many Fishery Resources projects were involved with the protection and restoration of endangered and threatened fish species. Fishery assistance personnel at Gatlinburg, Tennessee completed the third and final year of monitoring activities on the endangered Okaloosa darter (*Etheostoma okaloosae*). This fish is endemic to six relatively small streams on the Eglin Air Force Base in northwest Florida. A review of the fish's status was also conducted to assess the effects fish stocking on the base might have on this darter. Other personnel in Tennessee continued investigations on 5 endangered or threatened fish species, 16 endangered mollusks and crustaceans proposed for listing in Tennessee, 5 endangered mollusks, and 1 fish and 1 crustacean proposed for listing in Kentucky.

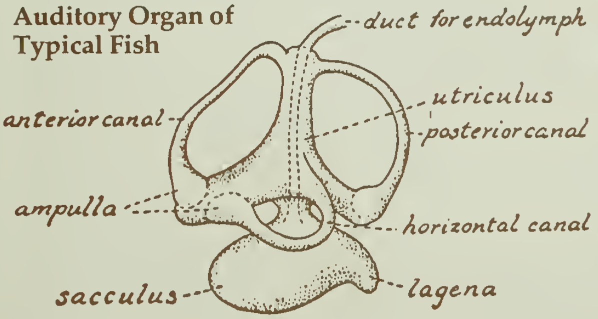
Fishery resources biologists in Pennsylvania were assisted by the Pennsylvania Fish Commission in electrosampling French Creek below the Union City Dam in an attempt to locate the blue pike. Reports indicate the blue pike has been caught on several occasions, but none were collected during the sampling. The status of this fish remains questionable.

Personnel of the Reno, Nevada, Fishery Assistance Field Station continued the cooperative effort with Indians to restore the endangered cui-ui sucker to Pyramid Lake. Projects included the continuation of artificial propagation, a systematic sampling program to assess the spawning population, evaluation of cui-ui passage problems at the Pyramid Lake Fishway, and completion of a detailed age and growth study. The propagation program has been in operation since 1973, with approximately 7.8 million larval cui-ui being produced and released into Pyramid Lake and the Truckee River. Consultations were also completed for three Federal projects affecting cui-ui habitat.

In FY 78, a total of 66 3- to 5-year-old greenback cutthroat trout (*Salmo clarki stomias*) were collected from Como Creek, Colorado, and moved to the Bozeman Fish Cultural Development Center in Montana. These fish will provide a stock for reintroducing the species into their original range through a cooperative effort by the Greenback Cutthroat Trout Recovery Team.

Several of the national fish hatcheries are culturing endangered or threatened species of fish. The Dexter National Fish Hatchery in New Mexico is culturing exclusively endangered fish species of the southwestern United States. At present, 10 of the 12 species held at Dexter have successfully reproduced. The objectives of this program are to maintain a protected gene pool, reproduce and propagate species, develop techniques for successful propagation, conduct research, and provide opportunities for university personnel and students to work with these fish. The species cultured at the Dexter hatchery include the Amistad, Big Bend, and Pecos Gambusia, the Commanchee Springs and Leon Springs Pupfish, the Yaqui and Chihuahuan Chubs, the Beautiful Shiner, Woundfin, Fountain Darter, Gila Topminnow, and the Yaqui Sucker.

The native and threatened species program in Yellowstone National Park continued in FY 1978 with efforts to restore the Montana grayling into Canyon Creek, a spring-fed creek in the park. One stocking of 5,000 Montana grayling fry was made in Canyon Creek in 1978. The cooperative program between the National Park Service and the Wyoming Game and Fish Commission, started in 1977, was continued in 1978. Approximately 500 adult and subadult Sedge Creek cutthroat were collected and flown to a previously fishless stream in the Teton Wilderness Area. In a similar project, the Heart Lake cutthroat, which has been identified as being vulnerable to extinction in the park, was transplanted to Picket Lake in the park for the second year. The transplant of 1,000 wild cutthroats by helicopter followed rehabilitation of the lake in 1977 to remove a stunted brook trout population. Field surveys searching for relict fish populations continued, as did the inventory to find suitable waters for use as enclaves for vulnerable or threatened species.


Auditory Organ of Typical Fish

Otolith of Cod

Otolith of Meagre

Training

Training Begins At New Fisheries Academy

The Fisheries Academy in Leetown, West Virginia, was organized in FY 1978 to provide professional fisheries training for Fish and Wildlife Service fishery biologists and for other Federal, State, private, and foreign biologists as space allows. The academy is committed to the continuing education and development of fishery managers and will provide practical courses intended to promote better field management. Experts within government, industry, and universities will conduct training courses to provide the best, most up-to-date information available.

Several courses traditionally taught by fishery research staff are included in the academy's program, including the long course on fish health conducted at the Fish Health Research Laboratory and a long course for hatchery managers given by the Spearfish National Fish Hatchery in South Dakota. During FY 1979, courses given at the academy will also include fish genetics; electrofishing; hydraulics and hydrology for fishery biologists; farm pond management; coldwater fish culture; fisheries legislation; and indirect fluorescent antibody test for diagnosis and detection of furunculosis, enteric redmouth disease, and bacterial kidney disease. In the future, courses will be developed and updated as new information becomes available.

Other Training Activities
Training activities continued at many fishery resources facilities during FY 1978. At the Ft. Morgan Fish Disease Control Center in Colorado, a workshop was conducted for Service biologists and biologists from Montana and South Dakota on sample collection. A 2-week training course in fish virology and cell culture was presented to fisheries biologists from the Mexican Fisheries Department to aid in establishing a fish health laboratory in Mexico City. In addition, an environmental education program for native Americans was developed with the Bureau of Indian Affairs.

Twenty trainees from Federal, State, and private fishery organizations attended a short course on fish health given at the University of Wisconsin by the fishery staff from the Genoa Hatchery Biologist Laboratory. Over 100 individuals have attended this course since it was first offered in 1971.

Scales

Armoured Catfish *Perch* *Troutperch* *Carp*

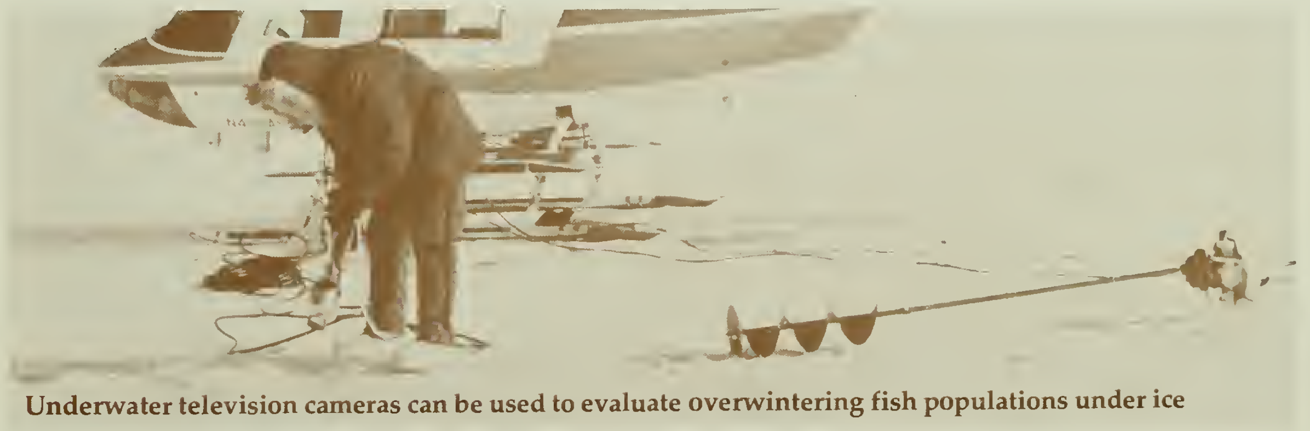
Cooperative Projects

Many fishery resources activities are done in cooperation with other agencies and programs, thus ensuring that assistance, production, and research efforts are well coordinated. For example, the Delaware River Fishery Project is a cooperative study sponsored by the States of Delaware, New Jersey, New York, and Pennsylvania; the National Marine Fisheries Service; and the Fish and Wildlife Service. The objectives of this study, jointly funded by the States and the Federal government under the Anadromous Fish Conservation Act, are to conduct applied research on various aspects of anadromous fish populations utilizing the Delaware River, to develop a Comprehensive Fishery Management Plan for the major species of the Delaware Basin and to coordinate all fishery research activities conducted by Federal, State, or private agencies. During FY 1978, efforts on the research segment were concluded and completion reports are being prepared on two principal phases of the investigation: the tributary utilization study and the population estimate of American shad.

Fishery surveys on the National Petroleum Reserve-Alaska were completed in FY 1978. An estimated 10 to 30 billion barrels of recoverable oil and 90 trillion cubic feet of gas underlie this 37,000-square-mile area of north-central Alaska, but development could have adverse impacts on the resident fish and wildlife populations. Arctic conditions make sampling fish populations very difficult, but new techniques may help to alleviate this problem.

In FY 1978, 29 lakes and 7 river systems were surveyed, and underwater television cameras were used to evaluate overwintering fish populations and habitat. Preliminary results from these tests indicate that portable underwater television equipment can be viable tools in fish overwintering studies in the Arctic. The data collected during the past two years have been submitted to the Bureau of Land Management for compilation in a report that will be submitted to Congress to assist in determining how the reserve will be used and developed.

Fish and Wildlife Service biologists participated in the review of National Park Service (NPS) fishery resource policies and management programs in FY 1978. The NPS Fishery Policy Task Force established work groups in each Service region and in Alaska to advise NPS staff and to review present policies and management plans for both freshwater and saltwater fish species. The national task force leader is compiling the findings of the regional work groups into a report of the NPS fishery resource policies on a nationwide basis.



Underwater television cameras can be used to evaluate overwintering fish populations under ice

Construction and Engineering

Many fishery resources facilities require maintenance and repair to continue to provide the quality and numbers of important sport and commercial fish species desired by the Nation's fishermen. New facilities are also constructed when their need is identified. During FY 1978, many minor repair and improvement projects at national fish hatcheries were undertaken or completed through the assistance of enrollees in the YACC and the YCC. The young people involved in these programs provided many hours of valuable assistance to fishery resources personnel. Participants at the YACC camp in Spearfish started restoration work on the historic Spearfish hatchery building recently designated as a National Historical Site. The Service will continue to cooperate with these programs in FY 1979.

Design and construction of water collection systems and raceways continued at the Iron River National Fish Hatchery in Wisconsin and applications for the necessary environmental permits were filed with the State. Construction of the hatchery will begin in FY 1979 as soon as permits are obtained. Fish production facilities will be expanded and ponds rehabilitated at the Senecaville and Hebron National Fish Hatcheries in Ohio. In Washington, construction was completed at Winthrop and Leavenworth National Fish Hatcheries, and a contract awarded and construction begun for facilities at Entiat National Fish Hatchery. When completed, these facilities will be able to boost production of spring and summer chinook salmon to over 6 million smolts annually. Work on Warm Springs National Fish Hatchery in Oregon was nearly completed in 1978, with final work scheduled for 1979. At the Coleman National Fish Hatchery in California, work continued on the hatchery water facilities.

Construction of hatchery building additions at the Green Lake National Fish Hatchery in Maine was completed during FY 1978. Forty additional rearing ponds were built, which completes the planned number (102) of rearing ponds, and three effluent control ponds were added to the three ponds previously built.

The National Fishery Research Laboratory at LaCrosse, Wisconsin, was dedicated in FY 1978. Two of the three main structures were finished, and three wells were developed. Other facilities were also completed, including a facility for wastewater treatment, concrete pools and raceways for culturing fish and testing chemicals, and earthen ponds for fish culture and chemical exposures.

The White River National Fish Hatchery at Bethel, Vermont, was nearly completed during FY 1978. The river intake structure is also being redesigned to take in a greater volume of water for hatchery needs.

Shitike Creek, the

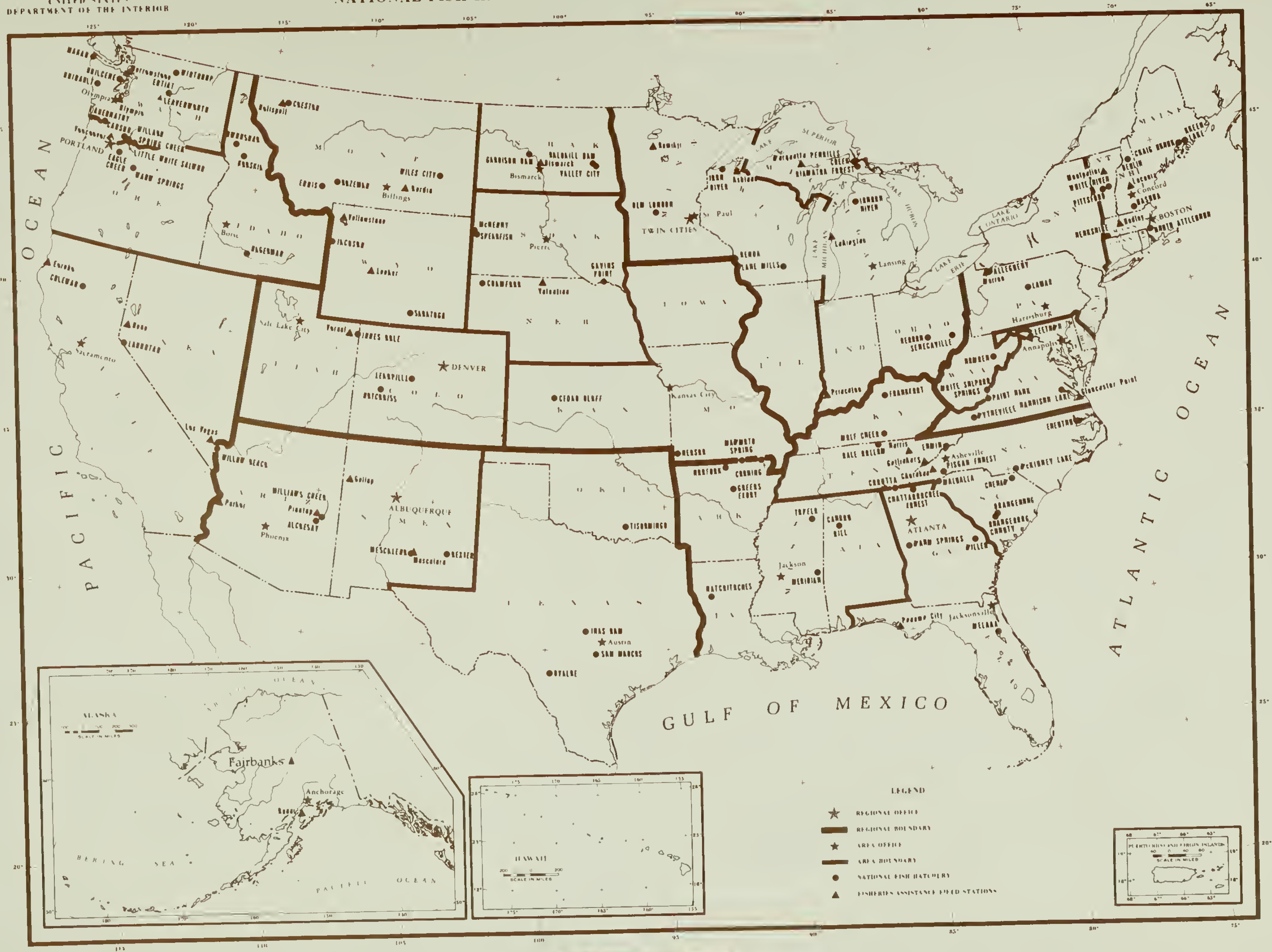
second largest steelhead production area on the Warm Springs Indian Reservation in Oregon, has a passage problem at a poorly designed fish ladder about 7 miles upstream from its confluence with the Deschutes River. Regional office engineers redesigned the fish ladder this year. Completion of the redesigned fish ladder will allow better utilization of an excellent spawning area above this problem passage.

APPENDIX

UNITED STATES
DEPARTMENT OF THE INTERIOR

NATIONAL FISH HATCHERIES AND FISHERIES ASSISTANCE STATIONS

UNITED STATES
FISH AND WILDLIFE SERVICE



SCALE IN MILES

COMPILED IN THE DIVISION OF REALTY

WASHINGTON, D.C. SEPTEMBER 30, 1977

Fish and Fish Egg Distribution by Major Groups

Fiscal Year 1978

	Warmwater includes bass, sunfish, catfish, etc;		Coolwater includes yellow perch, walleye, sauger, northern pike, muskellunge, etc;		Non-anadromous Salmonid includes rainbow, brown, brook and other trout species		Anadromous Salmonid includes Pacific and Atlantic Salmon		Other includes crawfish		Total	
	number	pounds	number	pounds	number	pounds	number	pounds	number	pounds	number	pounds
eggs	62,400	**13**	5,912,000	**164**	10,574,135	**1,672**	22,554,316	13,777			39,102,851	**15,626**
fry	2,609,625	**507**	39,336,240	**770**	1,005,523	**9,029**	6,596,552	**5,242**			49,547,940	**15,548**
fingerlings	45,712,373	**186,925**	9,693,593	**6,115**	20,594,389	**960,286**	77,284,706	**1,871,431**			153,285,061	**3,024,757**
adults	492,236	**113,150**	480	**172**	13,566,137	**3,133,911**	1,723,241	**291,629**	4000	80	15,786,094	**3,538,942**
total	48,876,634	**300,595**	54,942,313	**7,221**	45,740,184	**4,104,898**	108,158,815	**2,182,079**	4000	80	257,721,946	**6,594,873**

Summary of Fishery Assistance on Areas Served

Fiscal Year 1978

AGENCY SERVED	NUMBER OF AREAS SERVED	ACRES OF IM-POUND-MENTS	MILES OF STREAMS	HATCHERY FISH STOCKED		MAN-DAYS OF FISHING
				LBS.	NO.	
Air Force	32	2,656	33	46,057	219,285	271,570
Army	66	23,703	341	96,036	1,278,804	725,375
Navy & Marines	30	5,848	188	16,949	105,625	270,587
National Forests	13	11,925	1,759	301,400	971,900	2,620,700
National Parks	11	135,251	5,674	52,100	35,899	551,420
National Wildlife Refuges	58	396,749	326	51,910	3,193,355	1,449,201
Veterans Administration	23	165	0	4,852	25,150	25,668
Other Federal Areas	13	320	4,000	5,100	27,800	55,130
Indian Reservations	100	493,403	8,440	818,754	14,175,212	1,863,453
Federal-State Cooperative Areas	50	10,584	312	244,850	1,299,301	972,445
Other Public Waters	9	1,598	79	1,182,620	54,954,100	256,841
Private Waters	4	31	0	0	0	2,700
TOTALS	409	1,082,233	21,152	2,820,628	76,286,431	9,065,090

Distribution of Anadromous Fish Conservation Act Funds

State Allocations for
Fiscal Years 1967-1978

STATE	FISCAL YEARS 1967-1970	FISCAL YEARS 1971-1975	FISCAL YEAR 1976	FISCAL YEAR 1977	FISCAL YEAR 1978	TOTAL
Alabama	20,000	113,000	17,500	20,000	25,000	195,500
Alaska	309,400	366,750	358,095	174,200	177,000	1,385,445
California	1,045,625	959,500	335,500	246,000	249,000	2,835,625
Connecticut	72,450	169,233	24,000	104,000	45,000	414,683
Delaware	136,413	235,000	31,300	29,000	49,000	480,713
Florida	30,000	60,000	–0–	–0–	–0–	90,000
Georgia	69,388	136,550	31,000	33,000	25,000	294,938
Illinois	5,000	20,000	10,000	10,000	32,500	77,500
Indiana	15,000	135,000	34,500	30,000	55,000	269,500
Louisiana	27,800	125,000	15,000	20,000	20,000	207,800
Maine	650,675	276,950	71,250	91,500	61,000	1,151,375
Maryland	58,022	70,500	50,000	–0–	–0–	178,522
Massachusetts	93,987	242,354	47,100	58,000	37,000	478,441
Michigan	2,140,000	1,590,000	300,000	281,500	317,800	4,629,300
Minnesota	99,314	380,700	109,000	90,300	85,000	764,314
Mississippi	55,000	87,500	17,500	17,500	17,500	195,000
New Hampshire	63,638	303,352	34,900	18,300	37,600	457,790
New Jersey	43,230	99,750	18,750	19,000	19,500	200,230
New York	155,238	773,982	551,700	696,200	455,500	2,632,620
North Carolina	31,187	145,000	70,000	87,500	97,500	431,187
Ohio	15,000	–0–	–0–	–0–	42,500	57,500
Oregon	781,520	832,732	178,000	179,000	250,800	2,222,052
Pennsylvania	67,625	308,000	150,605	120,700	164,800	811,730
Rhode Island	53,500	96,595	23,500	–0–	–0–	173,595
South Carolina	69,200	285,500	73,000	86,500	89,000	603,200
Vermont	25,525	66,482	6,800	6,800	6,800	112,407
Virginia	238,437	215,000	20,000	–0–	–0–	473,437
Washington	716,300	657,020	414,000	574,000	552,200	2,913,520
Wisconsin	396,526	1,273,550	292,000	292,000	340,000	2,594,076
TOTAL	$7,485,000	$10,025,000	$3,285,000	$3,285,000	$3,252,000	$27,332,000

Appendix

Alabama

Hatchery Production and Stocking

AFCS-6
FY 78 Allocation $25,000

To produce fingerlings and determine tag loss and fouling and maximum stocking densities in cage rearing of striped bass to be stocked in Alabama estuaries.

Alaska

Southeast King Salmon Investigations

AFS-41
FY 78 Allocation $59,000

To determine the contribution of Alaska chinook salmon stocks to southeastern Alaska fisheries and to determine the feasibility of increasing the sport catch by pond rearing and smolt stocking.

Southeast Alaska Steelhead and Sea-run Cutthroat Trout Investigations

AFS-42
FY 78 Allocation $38,600

To determine the life history of steelhead and sea-run cutthroat trout in the Petersburg Creek system.

Mendenhall Salmon Rearing Ponds

AFS-43
FY 78 Allocation $59,450

To convert seven lakes (30.8 acres) to salmon or steelhead smolt rearing ponds for stocking in the Mendenhall River.

Russian River Red Salmon Study

AFS-44
FY 78 Allocation $19,950

To determine escapement, reproduction and other life history facts of red salmon on the Russian River.

California

Mad River Fish Hatchery Operations

AFS-15
FY 78 Allocation $85,000

To augment north coastal fisheries for steelhead and salmon by rearing and releasing annually 1 million yearling steelhead and silver salmon in combination and 5 million king salmon.

Coastal Steelhead Study

AFS-16
FY 78 Allocation $33,000

To investigate ways and means of increasing the production and yield of adult steelhead in California's north coastal streams.

American Shad Study

AFS-17
FY 78 Allocation $66,000

To determine size of runs, distribution, and utilization, particularly in the major central valley streams.

Trinity River Anadromous Fish Study

AFS-20
FY 78 Allocation $65,000

To determine salmonid harvest and escapement, juvenile life history and emigration and to evaluate the Trinity River Hatchery in order to determine the causes of the decline in anadromous fish runs.

Connecticut

Connecticut River Basin Anadromous Fishery Research and Management

AFS-4
FY 78 Allocation $25,000

To determine research and management needs in the Basin and design a program to meet them.

Upper Collinsville Dam Fishery

AFS-6
FY 78 Allocation $20,000

To construct fishway on Farmington River at existing dam to allow passage of shad, alewives, and possibly Atlantic salmon. Located on the Connecticut River system near Hartford. Dam is State-owned.

Delaware

Delaware River Basin Studies

AFS-2
FY 78 Allocation $24,000

To develop the sport and commercial fisheries of the Basin with emphasis on American shad and striped bass.

Restoration of Shad Run in Brandywine Creek and Its Tributaries

AFSC-4
FY 78 Allocation $1,000

To restore runs of anadromous fishes to Brandywine Creek within the States of Delaware and Pennsylvania and thereby provide an estimated additional 30,000 man-days of recreational fishing annually.

Brandywine River Fishway Repair

NEW
FY 78 Allocation $20,000

To repair or temporarily secure the existing fishways on the Brandywine River.

Georgia

Enhancement of Striped Bass in Ogeechee River

AFS-11
FY 78 Allocation $25,000

To produce striped bass fry and rear fingerlings for stocking in the Ogeechee River to enhance the striped bass fishery.

Illinois

Purchase of Chinook Salmon Smolts

AFS-3
FY 78 Allocation $20,000

To purchase 400,000 chinook salmon fingerlings from Michigan for release in Lake Michigan.

Assessment of Anadromous Fish Resources

NEW
FY 78 Allocation $12,500

To assess availability and catch of anadromous fish species in Lake Michigan by contract netting and creel census methods.

Indiana

Lake Michigan Anadromous Fish Stocking

AFS-3
FY 78 Allocation $30,000

To maintain the existing salmonid fishery by stocking 100,000 each of coho salmon, brown, and steelhead trout, and 200,000 chinook salmon annually.

Trail Creek Egg Taking Station

NEW
FY 78 Allocation $25,000

To construct egg-taking station for purpose of providing salmon and trout eggs sufficient to meet hatchery needs for stocking Lake Michigan.

Louisiana

Striped Bass Production

AFS-6
FY 78 Allocation $20,000

To operate and maintain anadromous striped bass hatchery constructed under a previous project.

Maine

Evaluation of Penobscot River Migrations

AFS-12
FY 78 Allocation $28,000

To evaluate the effectiveness of the Penobscot Model River restoration program.

Development of Shad and Smelt Fishery Resources

AFS-19
FY 78 Allocation $25,000

To restore American shad in barren coastal streams and assess smelt sport fishery.

Evaluation of Salmon Spawning Sites and Winter Habitat

AFS-20
FY 78 Allocation $8,000

To assess potential Atlantic salmon spawning areas in Maine rivers to maximize use of these areas in management of this fishery.

Massachusetts

Connecticut River Basin Studies

AFS-4
FY 78 Allocation $26,000

To determine research and management needs in the Connecticut River Basin and to design a program to meet them.

Merrimack River Basin Restoration Program

AFS-10
FY 78 Allocation $11,000

To investigate the Merrimack River Basin in Massachusetts and New Hampshire to determine feasibility of restoring runs of anadromous fish. To coordinate and implement an anadromous fish restoration plan.

Michigan

Production of Anadromous Salmonids

AFS-12
FY 78 Allocation $130,000

To produce 100,000 pounds of smolts at Platte River Hatchery for release into Great Lakes.

Fish Passage, Weirs and Barriers

NEW
FY 78 Allocation $187,800

To construct fishways, weirs, traps, and sea lamprey barriers to increase spawning and sport fishing areas, to prevent spawning of sea lampreys, and to facilitate spawn-taking for hatchery purposes. Includes 12 separate projects of which 10 are new in FY 1978.

Minnesota

Improvement of Sport Fishing for Anadromous Species

AFS-3
FY 78 Allocation $45,000

To increase the sport fishing opportunities and the quality of angling for certain anadromous fishes on streams tributary to Lake Superior, through habitat improvement and annual stocking of up to 300,000 steelhead trout and coho salmon smolts.

French River Hatchery Operation and Maintenance

NEW
FY 78 Allocation $40,000

To produce salmon/steelhead at newly constructed hatching and rearing facility at French River.

Mississippi

Hatchery Production

AFSC-5
FY 78 Allocation $17,500

To establish populations of

striped bass which will utilize the coastal streams, the estuaries, and open Gulf of Mexico waters by stocking striped bass strains which are known to utilize each type of water.

New Hampshire

Connecticut River Basin Anadromous Fishery Studies

AFS-4
FY 78 Allocation $20,000

To determine research management needs in the Connecticut River Basin, and to design a program to meet those needs.

Coho Salmon Introductions

AFS-5
FY 78 Allocation $6,000

To establish a coho salmon fishery in New Hampshire's Great Bay, Little Bay, and Piscataqua River area.

Merrimack River Basin Restoration Program

AFS-10
FY 78 Allocation $11,600

To restore American shad and Atlantic salmon in the Merrimack River. Activities include planning, research, and coordination.

New Jersey

Delaware River Basin Anadromous Fishery Studies

AFS-
FY 78 Allocation $13,000

To develop the sport and commercial fisheries of the basin with special emphasis on American shad and striped bass.

Shad Study, Raritan River

AFS-6
FY 78 Allocation $6,500

To conduct surveys to determine feasibility of development program.

New York

Delaware River Basin Anadromous Fishery Studies

AFS-2
FY 78 Allocation $18,000

To develop the sport and commercial fisheries of the basin with special emphasis on American shad and striped bass.

Anadromous Trout and Salmon Hatchery Development

AFS-8
FY 78 Allocation $400,000

To construct a major hatchery for production of trout and salmon smolts for recreational fishing in Lake Ontario and its tributaries.

Anadromous Fish Enhancement in Lake Ontario

FA-2-R
FY 78 Allocation $27,600

To complete development of plan for Lake Ontario to serve as a baseline for research and management activities.

Fish and Wildlife Management Coordination

FWA-2-C
FY 78 Allocation $9,900

To participate in cost of administering the State's Federal Aid Program.

North Carolina

Anadromous Fisheries Research Northern Coastal Area

AFCS-11
FY 78 Allocation $38,500

To determine spawning times and nursery areas utilized by anadromous fish. To determine growth and movement of juvenile anadromous fish, year-class composition and movement, and utilization of adult anadromous fish.

Anadromous Fisheries Research Cape Fear River

AFCS-12
FY 78 Allocation $14,000

To conduct a detailed survey of anadromous fish and their spawning and nursery habitat for the purpose of developing sound management programs.

Anadromous Fisheries Research Neuse River

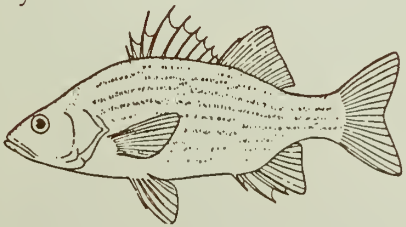
AFCS-13
FY 78 Allocation $14,500

To define the status, abundance, and vital statistics of the Neuse River anadromous fish populations.

Cooperative Management of Striped Bass

AFCS-14
FY 78 Allocation $30,500

To obtain appropriate data on Albemarle-Roanoke River striped bass in order to initiate and maintain realistic management of these stocks and their dependent fisheries on an optimum yield basis.



Ohio

Anadromous Fish Resource Enhancement

AFS-4
FY 78 Allocation $42,500

To stock into Lake Erie 400,000 coho and 300,000 chinook salmon smolts to produce 100,000 angler days of recreational fishing.

Oregon

Streamflow Requirements of Salmonids

AFS-62
FY 78 Allocation $37,200

Preliminary investigation to determine the relation of anadromous and resident salmonid production to streamflow.

Vibrio Immunization Study

AFS-67
FY 78 Allocation $21,000

To develop and evaluate mass oral inoculation of salmonid smolts in brackish rearing ponds against the saltwater disease vibriosis and to determine whether vibriosis is a significant factor in ocean mortality of salmonids.

Genetic Study of Anadromous Salmonids

AFS-68
FY 78 Allocation $39,000

To determine genetic characteristics, potential for change, and comparison of hatchery and wild anadromous salmoids.

Butte Falls Waste Treatment Pond

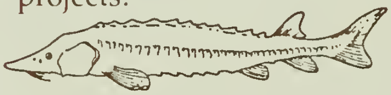
AFS-69
FY 78 Allocation $36,700

To reduce hatchery effluent discharge by construction of a waste treatment pond at Butte Falls Hatchery.

Biometrics

NEW
FY 78 Allocation $8,400

To consolidate statistical work now being carried out under four separate AFCA projects.



Smolt Study

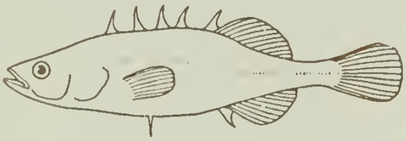
NEW
FY 78 Allocation $54,000

To gather data on life history, fecundity, time of migration, and survival of fish reared in hatcheries and streams. Data gathered will be used to maximize returns of hatchery fish.

Hatchery Improvements

NEW
FY 78 Allocation $54,500

To renovate and/or expand Rock Creek and Cedar Creek Hatcheries.



Pennsylvania

Delaware River Basin Anadromous Fishery Studies

AFS-2
FY 78 Allocation $20,000

To develop sport and commercial fisheries of the basin with special emphasis on American shad and striped bass.

Restoration of Shad Run in Brandywine Creek and Its Tributaries

AFSC-4
FY 78 Allocation $1,000

To restore runs of anadromous fishes to Brandywine Creek within the States of Delaware and Pennsylvania and thereby provide an estimated additional 30,000 man-days of recreational fishing annually.

Establishment and Maintenance of Pennsylvania Waters of Lake Erie

AFS-5
FY 78 Allocation $88,800

To establish chinook salmon in Lake Erie and to maintain populations of coho and chinook salmon in Lake Erie at a level which will provide a high quality sport fishery.

Shad Restoration Project on Schuylkill and Lehigh Rivers

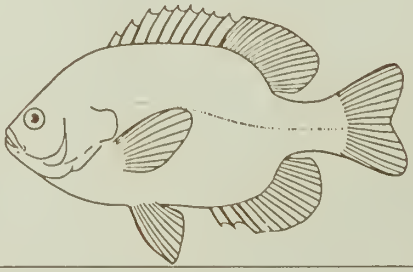
AFS-7
FY 78 Allocation $5,000

To conduct surveys of needs to implement program of shad restoration.

Improve Existing Holding Facilities

NEW
FY 78 Allocation $50,000

To increase production by 200 percent by improving existing holding and imprinting facilities for Lake Erie salmon program.



South Carolina

Detail Studies of the Santee and Cooper Rivers

AFS-3
FY 78 Allocation $44,000

To obtain biological, chemical, and physical data on the anadromous species in the Santee and Cooper Rivers.

Striped Bass Rearing and Stocking

AFS-6
FY 78 Allocation $45,000

To rear and stock anadromous striped bass for research and sport fishing purposes below the Santee-Cooper Dam.

Vermont

Connecticut River Basin Studies

AFS-4
FY 78 Allocation $6,800

To determine research and management needs in the basin and to design a program to meet those needs.

Washington

Operation of Fish Ponds

AFS-48
FY 78 Allocation $128,000

To operate fish ponds constructed with PL 89-304 funds to provide maximum production of steelhead and sea-run cutthroat migrants. A consolidated O and M project, replacing the former individual rearing projects.

Development of Anadromous Fish Catch Record System

AFS-56
FY 78 Allocation $54,500

To develop a computerized system for instantaneous daily estimates of the steelhead and salmon harvest to assure proper sharing of fish with Indians and to provide adequate escapement for perpetuation of the runs.

Nisqually Fisheries Enhancement

AFCS-85
FY 78 Allocation $42,500

To assess anadromous fish stocks on the Nisqually Reservation, to rehabilitate streams, and to expand hatchery and rearing facilities. This project is related to implementation of the Judge Boldt Decision.

Development of Fish Counter

NEW
FY 78 Allocation $50,000

To develop an acoustic fish counter for censusing upstream migrant salmon and steelhead. This project is related to implementation of the Judge Boldt Decision.

Fisheries Enhancement—Hoh Indian Tribe

NEW
FY 78 Allocation $20,400

To construct spawning and rearing facilities for chinook, coho, pink, and chum salmon. This project is related to implementation of the Judge Boldt Decision.

Cedar River Sockeye Spawning and Rearing Channel

NEW
FY 78 Allocation $256,800

To construct a new sockeye spawning and rearing channel on the Cedar River for Lake Washington. This project is related to implementation of the Judge Boldt Decision.

Wisconsin

Anadromous Fish Stocking and Evaluation

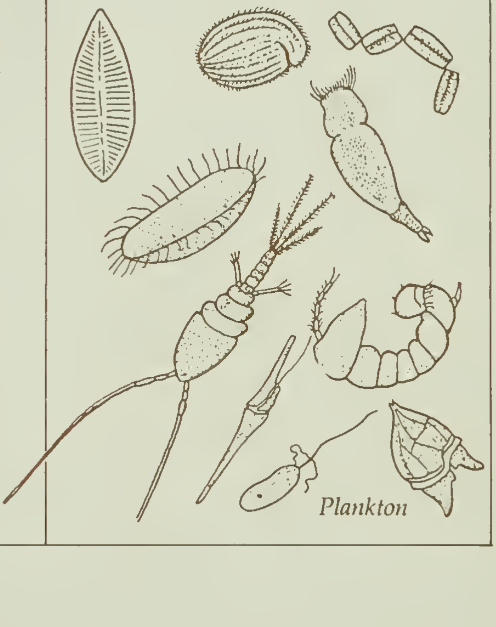
NEW
FY 78 Allocation $290,000

To continue the sport fishery evaluation, experimental introduction, and assessment of anadromous salmonid stocks in Lakes Superior and Michigan.

Sea Lamprey Barriers

NEW
FY 78 Allocation $50,000

To survey and select streams for construction of physical barriers against sea lampreys. One barrier per year will be constructed.



Plankton

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Department of the Interior

U.S. Fish and Wildlife Service

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.